CHEMISTRY

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Year

SOON? CHEMICALS AGAINST CANCER

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Broader Learning Earlier

➤ WITH THE accelerating pace of education, the rising generation not only finds out about more science facts and theories in more detail, but it acquires its knowledge earlier.

What was taught a few decades ago in the secondary schools is now often in the course of study of the upper elementary grades and the junior high school. Not too long ago, general science was a subject in the first year of the four-year high school. Now, if given at all, it is often encountered in the sixth or even fifth grade with just as much detail and sophistication.

The course curriculum efforts in chemistry for the high schools have upgraded what is learned just as science teachers have become more competent and better equipped with up-to-date information through the institutes that colleges have offered them in summer, after school and during the academic year, thanks to wise federal financing through the National Science Foundation.

As a consequence, during high school many boys and girls are learning more chemistry in more depth than previous generations did in the early years of college. Colleges are seizing upon this better chemistry preparation to give those so equipped advanced placement, often saving a year in the chemistry course, or allowing more to be taught in the undergraduate years. This is a gratifying advance that gives more educational "payload" for the future with the same expenditure in educational dollars and time.

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Real progress in man's fight against disease through chemicals will depend upon understanding of the complex chemistry of the human body.

Chemotherapy For Cancer Major Problem

by Dr. C. C. Furnas
Chancellor, University of Buffalo, Buffalo, N. Y.

Excerpts of remarks at an Honors Convocation of Thiel College, Greenville, Pennsylvania

The gaps in human knowledge em to grow greater, not less. Every w discovery opens new vistas for rther exploration. There may be a ne when everything that is humanly owable will be known, but that is least many centuries away.

Students of today need have no fear running out of research problems. here are three areas of future exoration which are difficult, intriing and of paramount importance. One of these is cancer.

A few years ago, modern science d raised the recovery rate to one in ery four cases.

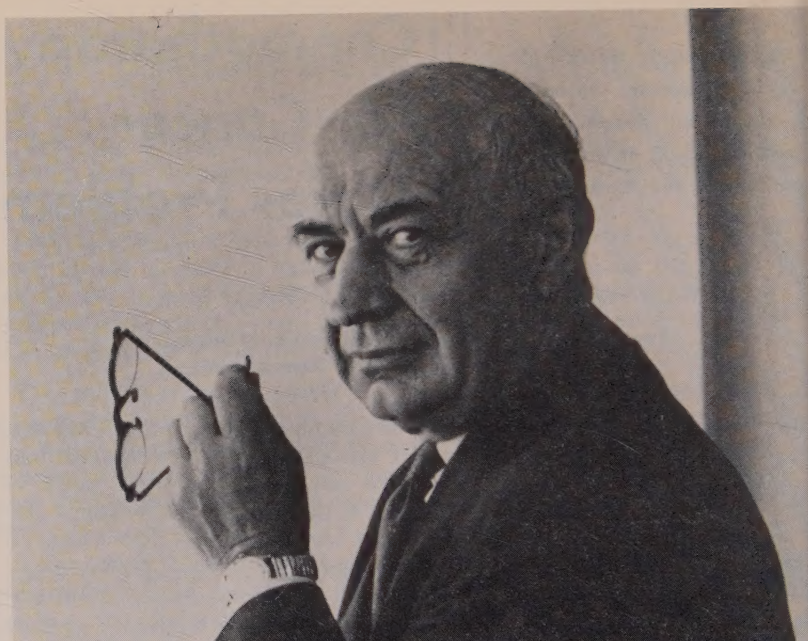
Today, the ratio of those saved is e in three, and some of the leading ncer researchers insist that if unirsal applications of the latest methls could be accomplished overnight, e rate would rise to one "cured" in ery two cases diagnosed. However, the present rate, of every six perns who get cancer, two will be saved d four will die.

Despite all the progress, last year out 259,000 Americans died of canr. This year 770,000 Americans will under treatment for cancer. Of this number, about 265,000 will die, if present rates are not checked. It is now the second greatest cause of death, led only by cardiovascular diseases. Out of every six deaths from all causes in the United States one is caused by cancer. Seven hundred twenty-five Americans, one person every two minutes, die of this disease every day.

Unless something new is brought into the picture, about 45,000,000 or one in four Americans now living, will eventually have cancer, according to figures of the American Cancer Society. Part of this high figure is due to the fact that medical science, by effective control of many diseases, now enables us to live much longer than formerly and cancer, in general, tends to strike in the later years of life .

For this reason, the older one gets, the more he searches for hopeful news of the knowledge of the causes and cures for cancer. You might say that after 50, one has a strong, vested interest in the subject.

From the data just given, you can see that research into the causes and cures for cancer is one of our most



Dr. C. C. Furnas

important problems. Where do we really stand? True advances have been made in knowledge, in diagnosis and treatment. However, the cures have been largely by the empirical or try-and-see route. This is good and is a monument to the medical profession but we need much more progress.

We need more basic knowledge from the biologists, the chemists and perhaps even from the physicists and mathematicians. Truly fundamental knowledge usually clarifies a complex situation. Let us look at the complexity.

Cancer is described in various wordy ways but it really boils down to being excessive and uncontrolle growth of a part of an organism. is not a single disease. There are as many as 150 to 500 different classe of human cancer, depending on wh is doing the classifying. It is not ju a human disease. Investigation ha shown that some forms of canc probably afflict all species of anima on occasion and certain plant disease are cancerous. It is a basic, eve though abnormal, phenomenon living cells.

The curative treatment of huma cancer has thus far been largely co fined to surgery or radiation. Surger if successful, removes the cancero

ss. Radiation by X-rays, radium or lioactive isotopes selectively destroys cancerous cells in place.

These are palliative measures — ccessful in an encouraging percent- e of the cases, but they do not get the heart of the matter, because we lly do not yet know what cancer lly is or what causes it.

A recent approach has hopeful pos- ilities. It is chemotherapy, the treat- nt of cancer with certain tested emicals. Exciting research is pro- ling in this field. Unfortunately, it still, for the most part, on an em- ical basis because we do not yet ow enough about the fundamental emistry of the living process to do nerwise.

More than $25,000,000 is spent each ar in testing some 40,000 chemicals cancer research. Some alleviation the disease and a few striking res have resulted from this work. ne results are such as to justify rther intensive investigation.

Most recent has been the positive idence that at least certain cancers animals are associated with and n be caused by specific viruses. Are man cancers part of this same pat- rn of cause and effect? We do not ow but from some of our great re- arch laboratories we may learn at ast a partial answer.

Wonderful as all this progress may , there is still something missing — e real understanding of the basic emical processes of living matter. hat we do not know.

It is my opinion that we cannot ally understand and cure abnormal owth, that is, cancer, until we grasp e fundamental chemical phenome- non of the living cell. Some day we will. How soon, I will not predict.

The real breakthrough might come in a few years or it may be centuries off. A handful of dedicated and brilliant men and women will lead the way. Where will they come from? No one now knows.

Psycho-Chemicals

Turn now to another distressing example of human frailty — mental illness.

Although hospitals are discharging patients at a faster rate than ever before, there are still some 750,000 in our mental hospitals, as many as are under treatment for all diseases in all other hospitals combined.

At least 17,000,000 Americans, one in every ten, are suffering from a mental or emotional disorder. These are figures released by the National Association for Mental Health.

Death is seldom directly attributable to mental illness, but the length of time required for a cure, if any, swells the hospital rolls. Directly and indirectly this scourge leads to immeasurable human misery.

These appear to be terrifying figures, and perhaps they are. If he is so minded, one can come to the conclusion that the world is rapidly going to the dogs, down the path of mental illness. Not only the number, but the proportion of the population in mental hospitals has increased very rapidly during the past few decades.

It must be admitted, however, that these results are partially matters of definition and attitude. The mentally ill person in today's categories would probably only have been classified as "eccentric" in grandfather's time.

Further, in the days gone by, there was a very severe social stigma attached to mental illness or, in more common parlance, craziness. Hence, those afflicted were kept under concealment as much as possible, often within the bosom of the family. It was only the socially dangerous persons who were committed to institutions.

Our attitudes have changed to the more rational one of the realization that mental abnormalities are illness in the true sense of the word and that alleviation and, in many cases, cures are really possible.

There is no firm evidence that the human race is becoming mentally more unfit as the years go by. Of course, it is true that many of the social strains of modern life bring out cases that would not have been noticed in the slower, more phlegmatic days.

Our social ways and mores only make the ailments more visible than before; they do not necessarily cause them. It is quite likely that the primitive and simple people of previous centuries were just as vulnerable and afflicted as we are today.

Of course, anyone under sufficient and continued mental strain can be forced into attitudes and actions which are not normal by socially acceptable criteria. Those cases, however, should be classed as temporary emotional upsets rather than basic mental illnesses.

Although the psychiatrists have succeeded in identifying and classifying mental illnesses with a high degree of reliability, we are still dreadfully short on knowledge of the basic causes. There is increasing evidence that in most, if not all, of the cases of true mental illness there is something ganically wrong with the hum body. The chemistry of the organis has gone awry in some way.

As in the case of cancer, there a many manifestations of the disea and undoubtedly many causes. some cases the mental disease has be proved to be caused by nutritio deficiencies.

For instance, there have been ma instances where the delirium treme associated with acute alcoholism h been dramatically cured or alleviat by heavy injections of the vitamin complex. Some other cases of men disorders are associated with end crine deficiencies associated with m functioning of the thyroid gland. such cases administering of thyrox or even iodine often brings about covery.

Those, however, are only the m obvious and simple cases. The bu of the mental maladies seem to caused by something much more co plex than those simple deficiencies.

Some very hopeful advances ha been made in recent years throu the path of the so-called psycho-che icals. These are various types of co pounds that have been found, empirical methods, to have some stri ing, even though temporary, men effects.

The "tranquilizers," which belo to this class of compounds, are no very widely used by the Americ public as well as by psychologist physicians and psychiatrists.

The psychiatrists have found th in an imposing percentage of the cas they are remarkable in improving t effectiveness of psychiatric treatme

his leads to very substantial dereases
the length of time spent in the
spital before cure is effected.

Quite a few years ago the "shock
atment" (which is actually not as
rrible as it sounds) began to be
ed as a method of treatment and
s proved to be effective in many
es. One type of this treatment in-
ved heavy doses of insulin. Another
e uses moderate electric shock.

Again, these approaches were made
the empirical or try-and-see process
her than because of a basic under-
nding of the chemistry or the com-
x workings of the human body.

These various efforts are now begin-
ng to show some beneficial effects
the records. The Bureau of Census
60 statistical abstract indicates that,
the first time since accurate data
ve been kept on the number of
se committed for treatment, the
oportion of the population com-
tted to mental hospitals has shown
decrease over the previous reporting
riod. The change is not large, but
is encouraging and probably indi-
es that progress is being made.

ture of Chemotherapy

Despite this hopeful information, it
probably a fact that real progress will be made only after there have been some true breakthroughs in the basic understanding of the extremely complex chemistry of the human body. I feel confident that happy day will come, even though I can certainly make no prediction as to when it will occur.

The fact that our vision cannot penetrate the crowded crystal ball should not discourage us. The past history of scientific progress can give us hope. For instance, 50 years ago — or even 20 years ago — any preventive treatment for infantile paralysis seemed to be out of the question.

Now we have truly preventive measures readily at hand and infantile paralysis, or poliomyelitis, would become as rare as smallpox if the public would now properly respond to the opportunities for immunization, which are easily available.

The future biochemists, the physiologists and the psychiatrists who will point the way to the prevention or the cure of the curse of mental illness may well be found among the college students of today. The challenge they will face should be an inspiration to those fortunate individuals who have the mental capacity and the flair for research.

SCIENCE PROJECTS HANDBOOK • This big book tells how to come a scientist and how to do projects that will have a chance to win nors in science fairs and in school science classes. You will be able to ad how 36 outstanding students did their honors-winning projects. Scien-ts collaborated in the lists for suggested ideas on important things to do exhibits for science fairs. Over 300 science books and magazines are ted. Send 50¢ in coin or stamps to CHEMISTRY, 1719 N St., N.W., ashington 6, D. C., and ask for "Science Projects Handbook."

Chemistry in Modern Medicine

New Drug Safely Reduces High Blood Pressure

➤ A NEW DRUG called CAPLA (mebutamate) was reported at a symposium to reduce high blood pressure without serious side effects.

CAPLA stands for Central Acting Pressure Lowering Agent, and is believed to quiet the overly active control centers in the brain and spinal cord, which are involved in the development of hypertension.

Dr. Harry Shubin, medical director of the Wolffe and Broad Street Hospitals in Philadelphia, told a meeting of the metropolitan chapters of the New York State Society of Internal Medicine that the drug had been effectively used to treat 100 patients suffering from various types of high blood pressure.

Good to excellent results were seen in 70% of those with essential hypertension, the most common form of high blood pressure. In 84% of the 93 patients with abnormally high diastolic pressure, CAPLA lowered the pressure to a normal range, Dr. Shubin said.

The new prescription drug was produced by Wallace Laboratories, Cranbury, N.J. Dr. Frank M. Berger, president and director of research, who discovered the drug, said it was the first to reduce high blood pressure without impairing the normal "regulatory mechanism of the body."

Although many drugs have be developed to control hypertensio their use is often complicated by c pression, severe nasal congestion, g tric acidity, diarrhea or constipatio

Drowsiness and headache are t only side effects reported with a frequency using CAPLA, Dr. Berg said.

Kidney Stone Remedy Saves Lives of Paraplegics

➤ A DRUG THAT dissolves kidney a bladder stones without irritation c save the lives of many paraplegi Dr. William P. Mulvaney, Univers of Cincinnati College of Medicine, ported to a sectional meeting of t American Urological Association Cincinnati, Ohio.

Paraplegics are patients with para sis of the legs and lower part of t body. Kidney or bladder stones fo in almost every paraplegic, Dr. M vaney said. They account for 30% the deaths of these patients.

Daily irrigation with the remed Renacidin, can prevent the formati of such stones in paraplegics, in wea ened patients and in those with o a single kidney.

When a stone already exists in k ney or bladder, Renacidin either d solves the stones or softens them that they can be crushed with an i strument.

B Drug Has Been Found o Prevent the Disease

A TUBERCULOSIS drug widely used t treat the disease has been found % effective in preventing it.

The drug, isoniazid, was used on ,000 persons who were in constant ntact with newly discovered TB ses, Dr. Luther L. Terry, Surgeon eneral of the U.S. Public Health rvice, reported.

Daily doses of isoniazid were taken the subjects under medical super- sion during a period when the risk getting the disease is normally very gh. It is not known, however, if e protection from the drug will last. he people studied will be observed r several years to see whether or ot the protection continues.

The Health Service also found that each 1,000 persons contacted in nnection with new TB cases, 19 ex- mined had the disease. This rate is out 30 times as high as that found X-ray surveys and shows the value examining those in contact with wly discovered TB cases.

emale Fertility Induced y Experimental Drug

NEW HOPE for barren women is en in a new experimental drug.

The drug, known as MRL/41, has duced egg-producing menstruation 28 (75%) of the women treated for normal absence of the monthly cle. Four became pregnant.

The important feature of MRL/41 its apparent ability to modify the rmonal balance between the pitui- ry gland and the ovaries. The pi- itary in the brain produces hor- ones that stimulate the ovaries, a nction essential to conception.

One puzzling point revealed in the study was that experiments on rats, which preceded the clinical tests, showed exactly opposite results. In both male and female rats, previous reports suppressed both ovulation (egg production) and fertility (ability to reproduce).

No serious toxic reactions involving the blood, kidneys or liver, occurred, researchers said. However, there were some adverse effects among patients during treatment with the drug, such as rashes and hot flashes.

MRL/41 is structurally related to chlorotrianisene, a synthetic female sex hormone, but it does not exhibit the expected activity in humans.

Results of the research were a surprise to the investigators. The drug holds much promise, but will not be available for prescription until further research is done, it was reported in the Journal of the American Medical Association (Oct. 14).

Drs. Robert B. Greenblatt, William E. Barfield, Edwin C. Jungck and Albert W. Ray of the Medical College of Georgia, Augusta, reported the study.

Earlier Drug Treatment Advised for Cancer

➤ THE LIVES of thousands of cancer patients could be saved or prolonged if drug treatment, not pain-killers, were begun earlier, Dr. Sidney Farber of Harvard Medical School said.

Summing up the current status of cancer treatment and the prospects ahead, Dr. Farber said it is doubtful whether more than 10,000 of the 260,000 patients who will die of cancer this year will have the benefit of cancer chemotherapy.

Instead of waiting until a patient is about to die or has an advanced state of cancer, Dr. Farger believes treatment with drugs should begin possibly even when the primary tumor is surgically removed.

Dr. Farber, speaking at the second conference on Experimental Clinical Cancer Chemotherapy in Washington, said "sufficient information is now at hand to permit research groups, particularly, to create programs designed to see if cancer metastases (spreading) can be prevented by adding chemotherapy" when the first tumor is removed.

Too many doctors, he said, believe that even when metastases have been demonstrated, it is best to wait until the patient "gets in trouble."

A team approach by the surgeon, the radiotherapist and the doctor who is an expert in chemotherapy would do much to increase the survival rate and total cure of those forms of cancer that are today affected by chemical agents, Dr. Farber said.

Cancer centers should be available in every large population center to help doctors care for their cancer patients, he said. Today there are 32 such centers in various parts of the country. One would be sufficient for the less-populated states, while cities like New York and Chicago would need several centers to provide information about the best modern treatment of cancer.

Three great directions of research are emerging that may eventually control cancer, Dr. Farber said. The largest is the search for drugs, the second is concerned with viruses and the third with immunology.

Lives of Children Stricken With Cancer Prolonged

➤ CHILDREN with eye cancer that h spread to other parts of the body ha received a new lease on life throug drug treatment.

Eight children suffering from e cancer that had spread to the bo marrow lived from two to 11 mont longer after treatment with a comb nation of three drugs, Dr. James Wolff of the Columbia Universi College of Physicians and Surgeon New York, said in Washington. T eye cancer strikes children under fo years of age.

The child who lived longest — months after the diagnosis of sprea ing cancer had been made — w treated with Cytoxan, a mustard co pound; actinomycin D, an antibioti and methotrexate, a folic acid a tagonist, first used in the treatme of leukemia.

For years, Dr. Wolff said, physicia did not know that retinoblastoma (e cancer) spread. In 1948, when he fir came to Columbia University, h found one patient who had this co dition but it was not until two yea ago that he began serious work screening children to find cases which the eye cancer had spread.

Out of 24 children with retinobla toma he found the eight who r sponded to drug treatment, Dr. Wol told the second conference on Exper mental Clinical Cancer Chemotherap

"Here was a lead to an involvemen we did not suspect," Dr. Wolff sai adding that he saw hope for longe survival as research progressed. "I looks as though triple therapy woul offer most promising results," he sai

Eighty percent of the children with tinoblastoma confined to the eye one survived five years.

ging Symptoms Confused ith Deficient Thyroid

AGING PATIENTS who appear senile ay be suffering from deficient pro- uction of thyroid hormone (hypo- yroidism).

In a study of 58 cases of hypothy- idism at the Oldham and District eneral Hospital, Oldham, Lanca- ire, England, researchers pointed it that results of treatment with a yroid extract were good, although ution had to be taken in treating ose with heart abnormalities.

The general practitioners who re- rred the aging patients to the hospi- l did not suspect thyroid deficiency 90% of the cases. Most were sent examples of heart failure, cerebral rombosis, anemia or bronchitis, with few labeled simply as "senile."

Treatment with L-thyroxine, a thy- id extract, might possibly have re- uced or even prevented hardening the arteries which afflicted many the patients. However, treatment ould be carried out in a hospital or nder the care of a medical attendant, rs. W. H. Lloyd and I. J. L. Gold- erg, now at the University College the West Indies, Kingston, Jamaica, ported in the British Medical Journal Nov. 11).

lastic Skin Used h Severe Burn Cases

MASS BURN casualties may in the future be treated temporarily with synthetic skin substitutes.

Synthetic skin is advantageous because great quantities, stored in sterile condition, can be applied as wound coverings, removed in stages and replaced later by successive skin grafts.

Dr. William M. Chardack of the Veterans Administration Hospital, Buffalo, N.Y., told the 68th annual convention of the Association of Military Surgeons in Washington that several children with more than 30% of their body covered with third-degree burns had been treated with good results using a plastic polymer.

Sheets of polyvinyl alcohol sponge as well as polyurethane foams of varying composition have been used. Studies of a number of spongy materials are planned to determine what is best.

The thickness of the synthetic skin sheet also needs further study before it can have widespread application.

Experience so far would indicate that a thin layer about one-seventh of an inch thick yields the best results, Dr. Chardack said. Heavier coverings apparently permit body fluid to accumulate in the pores not yet permeated by solid tissue, and could cause infection.

Dr. Chardack and his co-workers had previously experimented with animals. They found that the uniform flat layer of healing tissue remaining after the synthetic material was removed made an excellent surface for grafting material.

LATEST TABLE OF CHEMICAL ELEMENTS • There are now 103 nown chemical elements (most text books are not up-to-date enough to st all of them). For a periodic table send 10¢ in stamps or coin to CHEM- STRY, 1719 N St., N.W., Washington 6, D. C., for "Table of the Elements."

A Nobelist's Flash of Insight

➤ A FLASH of insight in Dr. Melvin Calvin's Nobel prize winning research came to him while he was parked waiting for his wife to finish shopping.

Dr. Calvin became the 11th Nobelist on the University of California campuses when he was given the 1961 prize for chemistry.

Commenting on the processes of research and inspiration, Dr. Calvin related that some years ago he and his colleagues had accumulated a considerable amount of new data on photosynthesis, the process whereby plants manufacture all of the food and other energy compounds on earth.

Dr. Calvin said some of this information was compatible with everything he knew previously. He was studying the path of carbon, by means of radioactive carbon 14, in the then-mysterious chemical steps by which plants turn the sun's energy, water and carbon dioxide into sugars, starches and proteins.

A number of the compounds, formed as the plant evolves successively more complex chemicals, had been identified. But a point had not been reached at which order could be brought out of the detailed information.

One day, Dr. Calvin recalls, drove his wife down town to do errand. The only place he could fi was in a no parking zone. He wait there, while she got out.

During a brief period of enforc waiting, while all he "had to do w think," he perceived that a "missin chemical called phosphoglyceric ac must be present in the process a must be the key to the whole pho synthetic cycle. After that, the ma outlines of the cycle fell into place his mind in a matter of 30 secon Some years were required to work out in detail.

It was for his brilliant work determining the essential chemi processes of photosynthesis that D Calvin was awarded the Nobel Pri in chemistry. The knowledge h enormous future potential in agric ture and food production. The wo was performed in the Lawrence Ra ation Laboratory and supported the Atomic Energy Commission.

"There is such a thing as inspi tion," Dr. Calvin comments. "I do know what made me ready for it that moment, except I didn't ha anything else to do. I had to sit a wait, and perhaps that in itself h some moral."

● WOULD YOU LIKE TO HAVE A RAINBOW? ●
Science Service will send you a small piece of diffraction grating with whi you can create an artificial rainbow and see the play of the spectrum colo You can prove for yourself that white light is made up of colored light. Fr upon request to CHEMISTRY, 1719 N St., N.W., Washington 6, D. C., a ask for "Free Diffraction Grating."

Copper

by Burton L. Hawk

Certainly copper must have been ne of the first metals used by man. rticles made of copper have been und which are more than 6000 years d! In those dim distant days, the etal seemed to have been used pri-arily for ornaments; apparently, ey did not get around to using it r electrical wiring or plumbing. It ust have been rather expensive too, r the prophet Ezra mentions "two ssels of fine copper, precious as old." (Ezra: 8:27.) Analysis of cient articles proves that they were ade of pure copper, and not of its loys.

Pure copper is a beautiful rose-pink lor. It soon becomes dull when ex-osed to the air. If you can obtain a ece of copper foil, dip a strip of it to alcohol. Remove and then ignite e alcohol adhering to the metal. Re-at this operation several times until e metal is a bright shiny rose-pink. his is the true color of pure copper. you cannot obtain the foil, try the xperiment with a piece of copper ire.

ow It Reacts

To test the reaction of copper metal ith various reagents, place solutions dilute nitric acid, dilute hydro-loric acid, dilute sulfuric acid, di-te glacial acetic acid and ammonium ydroxide in five test tubes, respec-vely. Drop a small piece of copper ire into each tube. Set the tubes ide for a while then check to see what reaction has taken place. The metal will have dissolved in the nitric acid to form a blue solution of cupric nitrate. It is not attacked by dilute hydrochloric or sulfuric acids. However, you should note a light blue coloration in the acetic acid and ammonia solutions; the metal is slowly attacked by these two compounds.

Now, place a piece of copper wire in *concentrated* sulfuric acid in a test tube. Here the reaction is quite different. The metal begins to dissolve almost immediately and sulfur dioxide (not hydrogen) is evolved. Cupric sulfate is also formed.

Although copper is quite stable in the air, it is soon coated with a green deposit of the basic carbonate if much moisture is present. When heated, it will slowly combine with the oxygen of the air. Obtain some copper powder by filing a piece of the metal. Place the filings in a metal container and heat gently. The copper soon turns reddish-brown as the cuprous oxide is formed. Continued and much stronger heating will result in the formation of the black cupric oxide.

Where It Is Found

Copper is found free and as the oxide, hydroxide, sulfide and carbonate in many parts of the world. Almost all countries produce some copper. In this country, the most important deposit is found in the Michigan peninsula. It is also produced from ores found in Utah, Montana, Arizona,

New Mexico and Tennessee. The oxide, hydroxide and carbonate ores are leached with sulfuric acid to form cupric sulfate which is then electrolyzed to obtain the metal. The sulfide ores are roasted with coke.

Heat Method

In the home laboratory, we can obtain the metal rather easily by heating the oxide with carbon or by electromotive series displacement. Mix thoroughly together one part of cupric oxide with two parts of powdered wood charcoal. Transfer the mixture to a large, dry hard-glass test tube. Apply heat, gradually at first, and finish up by heating quite strongly for a few minutes. Allow the tube to cool, then dump the contents out on a white piece of paper. Carefully examine the powder. If you have heated the mixture strong enough and long enough you will be able to find small particles of metallic copper.

Displacement Method

Now for the displacement method. As you probably know, copper is pretty far down on the list in the electromotive series. Thus it is precipitated from its solutions by any metal above it. Prepare a solution of cupric sulfate and drop a piece of zinc in it. Allow the solution to sta The blue color will gradually dis pear and pieces of copper will deposited on the zinc. The zinc, turn, has gone into solution to fo zinc sulfate. Place an iron nail in solution of cupric sulfate and it w be quickly covered with a layer copper.

The displacement of copper fr solution allows us to copper-plate jects by immersion. For example, y may copper-plate a dime if you wi (Although this is not practical wh you consider the cost of silver vs. t cost of copper.) Dissolve 3 grams cupric sulfate in 250 cc. of wat Add 1 cc. of sulfuric acid and s until all solids are dissolved. Po some of the solution into a shall glass dish. Drop in a clean silver di and also a clean iron nail. Make su that the nail just touches the edge the dime. The coin will be cover with a layer of copper almost i mediately. Turn it over to plate t other side. Allow to remain in t solution, in contact with the nail, o a minute or two. Remove and ca fully dry by blotting it with a s rag. Now you have a copper di Just think of all the fun you can ha by spending dimes as pennies!

• FOOD FOR ATOMIC SURVIVAL • If you want to see and experime with samples of the unusual materials and food that are recommended f atomic survival stockpiling and for distribution to the ill-fed regions of t world, obtain a novel experimental kit recently issued. It contains mul purpose food, a survival ration cracker, a special wheat grain, vitamin tablet and a material for purification of contaminated water. Send 75¢ coin or stamps to CHEMISTRY, 1719 N St., N.W., Washington 6, D. Ask for "Survival Food Kit."

New Theory on Radioactive Fallout

A NEW THEORY for predicting the ount of radioactive fallout from clear blasts has been developed by J.S. scientist. The accurate method limited to surface explosions.

With the United States steering ay from surface blasts, a computer odel" of the method is now being d to predict fallout dosages from ge and small nuclear weapons. The a will be helpful in planning lter programs and determining w long contaminated areas remain ot" with radioactivity.

Dr. Albert D. Anderson of the U.S. val Radiological Defense Laboraty in San Diego, Calif., based his thod on the following assumptions:

1. Fallout begins soon after detonation and way before the mushroom cloud reaches its maximum altitude.

2. The radioactive particles are uniformly scattered throughout the cloud.

3. The speed of a radioactive particle depends on the difference between the cloud's rising speed and the pull of gravity.

4. The time of a rising or falling particle to travel through a given layer is inversely proportional to the rate of rise or fall of the particle.

Fallout properties computed from the resulting formula compared very favorably with observed data from nuclear explosions conducted a few years ago, the scientists reported in the Journal of Meterology.

Earth Gets 10,000 Tons of Dust Daily

SOME 10,000 tons of dust rain down earth daily, three U.S. Scientists borted in London.

They base this figure on direct asurements of interplanetary dust rticles made in the earth's vicinity m U.S. and Russian rockets, satelis and space probes. The dust particles were measured from the noise they made when striking the space vehicles, Drs. C. W. McCracken, W. M. Alexander and M. Dubin of the National Aeronautics and Space Administration, Washington, D. C., reported in the British scientific journal, Nature.

THOUSANDS OF SCIENCE PROJECTS • This booklet lists the ssified titles of exhibits that have been actually done and shown at science rs and other exhibitions. It does not tell how to do the projects, but it es give ideas of what to do in more than 100 scientific fields. Detailed ggestions on how to do a scientific project are included as assistance to ence students who will enter science fairs this school year and to their chers. Send 25¢ in coin or stamps to CHEMISTRY, 1719 N St., N.W., ashington 6, D. C. Ask for "Thousands of Science Projects."

When It's Hot,
What Happens?

High Temperature Chemistry

by John L. Margrave

Department of Chemistry, University of Wisconsin, Madison, Wisconsin

➤ Have you ever stopped to wonder what happens to molecules when they get very hot? On a really hot day people shed their excess clothing as much as possible. At first glance one might expect molecules to do the same sort of thing, i.e., to shed their "coats" of weakly bonded atoms. One might generalize and say that chemical species should be simpler at high temperatures. This idea was fairly well accepted for many years, but recently optical spectroscopy, mass spectrometry, and highly refined measurements of chemical equilibria have provided evidence for many complex molecules at very high temperatures. These complex molecules are not only of chemical importance, but also have significance in geology and astrophysics.

Consider some of the possible vaporization reactions for elements that become vapors only at elevated temperatures. For carbon, at 2500°K and higher, the possible vaporization equations include

$$C(\text{solid} \rightarrow C(\text{gas})$$
$$\text{or } C_2(\text{gas})$$
$$\text{or } C_3(\text{gas})$$
$$\text{or } C_4(\text{gas})$$
$$\text{or } C_5(\text{gas}), \text{ etc.}$$

Perhaps you have never heard of these gaseous molecules, but they have been found in carbon vapor. The most plentiful species are C_3 and possibly C_5. Simple atomic carbon is not so important in the equilibrium vapor at 3000°C.

Studies of elementary silicon, germanium, tin, arsenic, and phosphorus also show evidence for complex molecules, sometimes with as many as eight atoms per molecule. Sodium vapor contains a small amount of $Na_2(g)$ at low temperatures, about 0.1% at 400°K. At 1100°K the amount of $Na_2(gas)$ in the saturated vapor over liquid sodium has risen to 12%. Increasing the temperature has been accompanied by an increase in the number of complex molecules!

But elements are not alone in showing complex behavior in the gas. Solid aluminum chloride has long been known to exist as a dimer in the vapor. Also, cuprous chloride vaporizes as gaseous Cu_3Cl_3, a trimer. Chemical mixtures, like an Al-Al_2O_3 mixture, also vaporize in unusual ways. It has recently been shown that Al-Al_2O_3 vaporizes largely as the $Al_2O(gas)$ molecule while a B-B_2O_3 mixture yields gaseous B_2O_2 molecules at high temperatures!

One can systemize these various vaporization processes by using the classifications: (1) direct vaporization, (2) vaporization as a polymer, (3) vaporization with partial decompos-

n, and (4) vaporization by decomsition to the elements. For example, e recent study has been concerned th lithium oxide and the question which of the following vaporization ocesses is appropriate:

$Li_2O(solid) \rightarrow Li_2O(g)$

or $2\ Li(gas) + \frac{1}{2}\ O_2(gas)$

or $LiO(gas) + Li(gas)$

ie results indicate that LiO(gas) ty be an important molecule in tain high temperature systems.

Many other materials must be died before we can claim a real derstanding of what happens in ses at high temperatures. The exence of gaseous hydroxides of ryllium, boron, gallium, silicon, ngsten, molybdenum, zinc and telium is well established; gaseous nitrides are probably important at the temperatures reached in the stars. Many very large and complex molecules like W_5O_{15}, Be_6O_6, $(HBO_2)_3$, $NaAlCl_4$ and $Na_2B_2O_4$ appear to vaporize as units. Thermodynamic reasoning can be applied to explain experimental observations, but unfortunately does not do a very good job of predicting what gaseous molecules are likely to be important in new systems.

High temperature chemistry is an open field today in which most of the classical chemical rules of valence and structure seem to fail. Many chemists will discover new molecules and bring forth new theories before we can completely answer the question, "When it's hot, what happens?".

Science Log Jam Solution

Use of a method of getting scienc reports into use without the exnse of costly printing is being urged a committee of the American ocumentation Institute, headed by alcolm Rigby of the American eteorological Society.

The technique consists of depositg typewritten reports, tables and otographs, with the Library of ongress, which will issue them upon mand in a photographic form. The ailability of the research reports is ade known by publication of a tice in a scientific journal.

This method of Auxiliary Publicaon, under the auspices of the Ameri Documentation Institute, was arted by Dr. Watson Davis of ience Service in 1937 as an attempt solve one of the most vexing problems then facing scientific societies and institutions.

The present number of documents on deposit under this plan is nearly 6,000 and the additions are at the rate of 500 a year.

Auxiliary Publication plans should be more widely used, Mr. Rigby feels, because of the explosive growth in manuscript material awaiting publication as compared to the less sensational growth in publication outlets. This is the result of an increase in the backlog of unpublished material necessitating either the reduction or condensation of lengthy papers.

It is believed because of this scientific publication log jam, many important research results are lost to industry, defense, and other fields of possible utilization.

√ Chemistry Quiz √

Directions: Mark the answer you think *most nearly correct.*
Answers are on page 33.

A. The solubility of a gas in water varies with its pressure in what way?
   1. directly
   2. inversely
   3. not at all
   4. unpredictably

B. The solubility of a gas in water varies with the temperature in what way?
   1. directly
   2. inversely
   3. not at all
   4. unpredictably

C. Which one of the following methods is not used for the purification of water?
   1. distillation
   2. filtration
   3. chlorination
   4. nitration

D. Which one of the following solutions is unstable?
   1. dilute
   2. supersaturated
   3. saturated
   4. concentrated

E. The main constituent of natural gas is
   1. hydrogen
   2. carbon dioxide
   3. methane
   4. carbon monoxide

Radiation Causes Gray Hair

➤ An explanation of why animals that go up in rockets sometimes develop gray hair was given on the basis of cell radiation. X-rays are responsible.

The irradiation is capable of killing or inactivating melanocytes, the cells in the skin that produce melanin (which includes a number of dark brown or black pigments).

But gray-haired persons may begin producing dark hairs following exposure to X-rays. Also, gamma rays (similar to X-rays but carrying more energy) can tan mice.

Drs. Herman B. Chase, William H. Straille and Claudette Arsenault of Brown University, Providence, R.I. reported on the graying effect of X-rays to a New York Academy of Sciences conference in New York.

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Condensation Polymers

by Thomas G. Andrews, Jr.

Bladensburg Senior High School, Bladensburg, Maryland

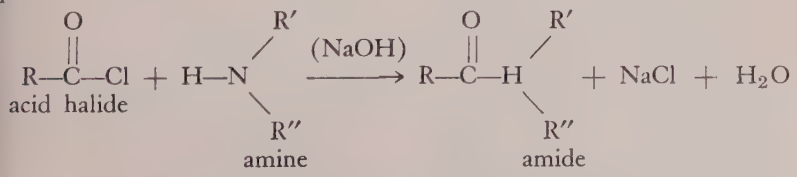
Thomas Gaylord Andrews, Jr., then 17, was a winner in the 20th Science Talent Search. He is now a chemistry major at Brown University preparing for a career as a research chemist.

Interfacial polycondensation is a ethod for preparing condensation olymers such as nylon. For many ears condensation polymerizations ave been applicable only to industrial onditions with high pressures and mperatures, and special sealed equipent. There has been a great need r a rapid, economical laboratory ethod of polymer preparation. The terfacial method was developed reently and is now being used in most esearch laboratories studying condenation polymerizations. The method equires only simple, open equipment, tmospheric pressure, room temperare and only a few minutes for the ctual reaction.

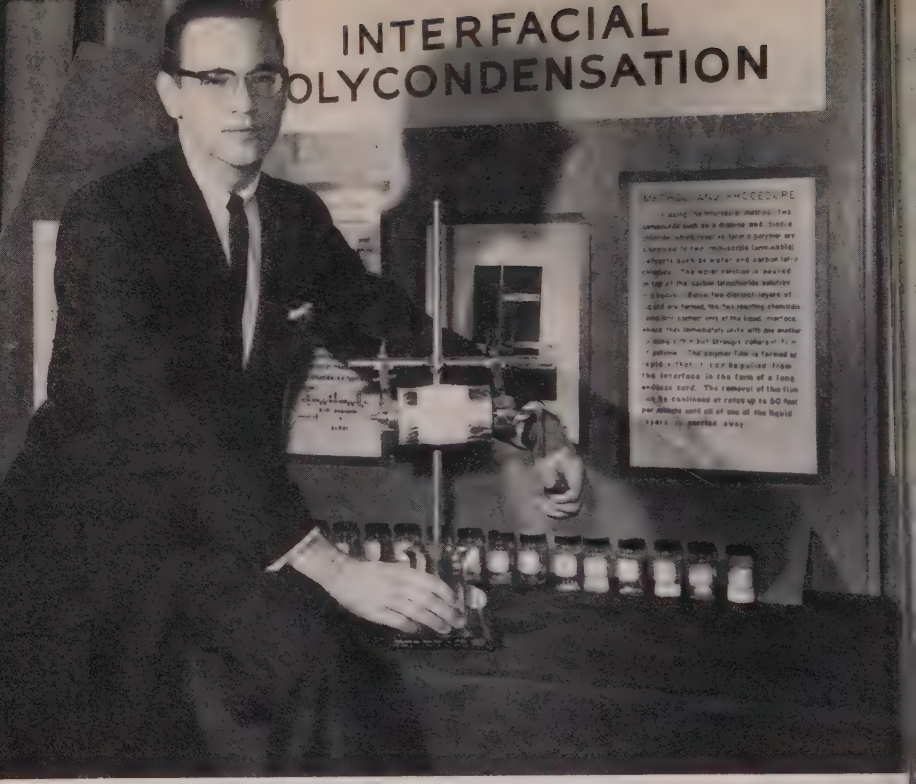
Polycondensation Reactions

A condensation polymer is a long chained molecule formed by the continual linking of two simpler organic compounds. The reaction occurs when these molecules unite by splitting out a water molecule or other simple molecule in the process. The basic condensation reaction used in my preparation of polymers is the old Schotten-Baumann reaction in which an organic acid halide is combined with a compound containing an active hydrogen atom. This active hydrogen would be contained in the organic functional groups such as -OH, -NH, and -SH. Here is an example of this reaction:

quation No. 1



(R-, R′-, and R″- are organic structures)



➤ Thomas Gaylord Andrews, Jr., *demonstrates the interfacial method of forming polymer film at the Twentieth Science Talent Institute in Washington. Thomas was one of the* 40 *Science Talent Search winners chosen from over* 25,000 *high school seniors throughout the country.*

If the two intermediates are bifunctional, that is, having a functional group at each end of the molecule, the intermediates can continually add onto each other to form a polymer of high molecular weight. The reaction of 1,6-hexanediamine and sebacoyl chloride to form 610 polyamide is a typical reaction of this type.

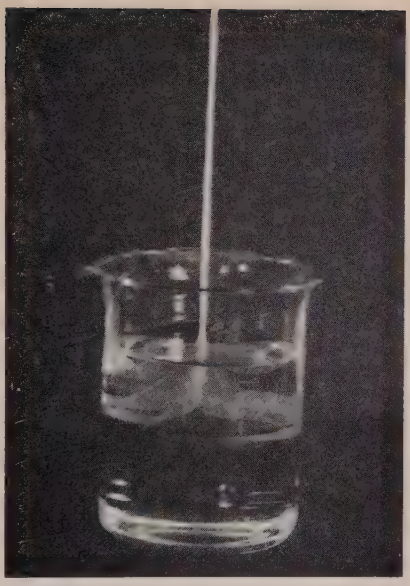
Equation No. 2

$$\mathrm{H_2N{-}(CH_2)_6{-}NH_2 + ClC{-}(CH_2)_8{-}CCl \longrightarrow \left[H\text{-}N{-}(CH_2)_6{-}N{-}C{-}(CH_2)_8{-}C \right]_x Cl + 2xHCl}$$

terfacial Method

This method carries out the polyndensation at the interface between o immiscible liquids, one of them cferably being water, the other be- g an organic liquid, such as carbon rachloride. Using the previous exnple of polyamidation, the diamine dissolved in water, and the diacid loride is dissolved in the organic quid. From this point there are two ssible methods that can be used — e unstirred and the stirred forms of terfacial polycondensation.

In the unstirred method the two lutions are carefully poured into a ssel, with the heaiver solution being ured first. A clear interface will rm between the two solutions and a n of polymer will form immediately this interface. The film is very thin t strongly coherent if the conditions e right. Usually irregularities, air cs, and bubbles are present. When is irregular film is pushed aside and e walls of the beaker are freed of rings of polymer, a smooth film is ain formed at the new interface. ne reaction occurs so rapidly that e film can be pulled from the center the interface with a pair of tweezers form a long, endless cord of polynide. An example of this is shown in e photograph. The film when being moved always forms a tent possessg shifting and draping folds with e apex at the liquid-air interface. ne film can be removed at rates of to 50 feet per minute. The simplest lation method is to wash the film th water and then with acetone to move any unreacted chemicals, and en to dry it. However, most of the ne the polymer swells to a certain tent, especially when using benzene



➤ A LONG CORD *of polyamide is being pulled from the film formed at the interface of the two liquids. The apex of the draping folds is at the liquid-air interface.*

for the organic liquid phase, and absorbs large quantities of both reacting solutions, thus creating a low yield and making drying and removal of unreacted chemicals difficult.

The stirred method brings the two solutions together rapidly with vigorous agitation. This is a highly desirable method. It produces high yields of powdered or granular products which are easily isolated, washed, and dried. Since the diacid chloride solution is more unstable than the diamine solution, it is added to the diamine solution. The stirred method sometimes produces polymers which are dissolved in the organic solvent, or

both phases may form an emulsion with the polymer. The polymer can be obtained from solution by evaporation of the organic solvent. Emulsions may be broken by addition of a water-miscible organic liquid, such as acetone, by evaporation of the solvent, or by addition of a very water soluble salt.

Methods and Procedures

For the polymers that I have prepared, I have utilized both the unstirred and stirred methods. The unstirred method was only applicable to a few of the polymers because in most cases the film if formed was not strong enough to be pulled from the beaker. The first polymer which I prepared was by the unstirred system. This polymer, which is commercially called 610 polyamide, is now being used as a lecture demonstration of the interfacial method by members of the du Pont research team which helped develop the method. Chemically this is called poly(hexamethylenesebacamide), and it is now being used commercially for nylon molding. The reaction used to prepare this polymer is shown in Equation No. 2 above.

The method I used for its preparation is as follows: An organic phase consisting of 2ml (0.0093 mole) of sebacoyl chloride dissolved in 100ml of carbon tetrachloride is placed in a 200ml tall-form beaker. Over this is carefully poured a solution of 2.2g (0.019 mole) of 1,6 hexanediamine and 1.5g of sodium hydroxide dissolved in 50ml of distilled water. A polymeric film is immediately formed at the interface. Molar equivalents of the two reacting chemicals are generally used, but sometimes a 10% or as in this case a larger excess of diamin will strengthen the resulting polymer The sodium hydroxide dissolved in the aqueous phase is used to neutralize the hydrogen chloride that is product of the reaction. If it is not neutralized the hydrogen chloride would react with the unreacted diamine and greatly lower the yield.

In using the stirred method for most of my polymers I carried out the necessary agitation by shaking the two phases vigorously in a large round bottom flask for several minutes. A more convenient apparatus would be a home blender, but one of these was not available for my use. In order to get an improved product the flask was shaken under a faucet of running cold water. This was done because a polymerization may warm up to 60°C from the heat of reaction and stirring action, which would cause sensitive diacid chlorides to hydrolyze when brought in contact with the aqueous layer.

In preparing a polymer by the interfacial method there are many variables which can affect the appearance, yield and molecular weight of the polymer. In most of the cases it was necessary to adjust some of these variables in order to obtain a suitable polymer. Among these variables are the choice of organic solvent, the purity of reactants, the use of various acid eliminators, the temperature at which the reaction takes place, the use of stirred or unstirred system, length of reaction time, and concentration ratio of intermediates in the two phases. For instance, in some cases one organic solvent would not produce any polymer, while another would give a very high yield polymer.

nalysis of Results

Sixteen different polymers were repared. The percentage yield in ich case was found by dividing the eight in grams of the final, thoroughly dried, product by the total weight f both intermediates. The melting oints were found on a melting point lock which has an upward limit of 30°C. I first corrected the block by refully recrystallizing several organic ompounds, such as benzoic acid, etanilide, and p-OH-C_6H_4-COOH, hich cover a range of melting points, nd then comparing their measured elting points with those found in e literature. The solubility was tested ith m-cresol, a common condensaon polymer solvent. The polymer as determined soluble if .125g of it issolved in 25ml of the solvent. If e polymer did not dissolve after a eriod of stirring and then sitting for everal hours, it was heated with irring until the polymer dissolved. the polymer did not dissolve after ntinuous heating and stirring it was nsidered insoluble.

The specific viscosity of a polymer the added viscosity which it gives a solvent when dissolved in it. In rder to get this viscosity ratio beween the solvent and the solution of e polymer in the solvent, the time takes for both liquids to flow from ne point to another in a viscometer measured. This time is determined y sucking the solution up into a ocket just above the first line on the iscometer and allowing it to flow ownward. Using a stopwatch the me is measured between when the eniscus of the liquid passes the first ne and when it flows past the second ne. After repeating these measurements about six times, an average is taken. This formula is used for the calculation of specific viscosity:

$$\frac{T_1}{T_0} - 1 = n_{sp}$$

T_1 = time of solution flow
T_0 = time of solvent flow
n_{sp} = specific viscosity

For these viscosity measurements it was necessary for the viscometer to be kept at a constant temperature of 25°C in a constant temperature bath. Also a constant concentration of polymer in solution had to be maintained for the experiments. The same solvent, m-cresol, and the same concentration of .125g per 25ml of solvent, was used. From these specific viscosity measurements a general idea can be obtained of the molecular weight of these polymers. Since several months are required to obtain a true idea of the molecular weight of any polymer even for a professional chemist using viscosity determinations, I will only briefly mention this method. Using a constant suggested to me for polymer No. 8 (see tables) this is the formula used:

$$\frac{n_{sp}}{cK} = M = \frac{.396}{.5 \cdot 10^{-4}} = 7900$$

n_{sp} = specific viscosity
c = concentration of solution in g/100ml
K = constant = $1 \cdot 10^{-4}$
M = molecular weight

Results and Conclusions

In this investigation sixteen different polymers belonging to different groups have been successfully prepared. All are polyamides. The groups are polyurethanes, formed from bis-

(chloroformates), polyorthophthalamides, and polyterephthalamides with some being polyamides alone. All of these polymers have been mentioned in the literature except those five prepared from N-(2-hydroxypropyl)ethylenediamine, which are the basic research part of my work. However, even for those mentioned in the literature, new methods and conditions had to be worked out, since those listed were too costly or elaborate for my use. These five new polymers are not mentioned in Chemical Abstracts, any of the chemical journals, patents connected with this work, and are unknown to chemists presently doing research in this field.

Each of these sixteen polymers was prepared after a period of several trials and errors and the best conditions and results of their preparation are listed in the appendix. Most of the polymers were tested for percentage yield, melting point, and solubility in m-cresol. Most of those that were soluble in m-cresol were tested for specific viscosity. The melting points taken fell in the general range of polymer melting points. Some of the polymers were already in too much of a liquid state for melting point determination. Most of the polymers were soluble in m-cresol except some made from N-(2-hydroxypropyl)ethylenediamine. This lack of solubility which made specific viscosity readings impossible with this solvent was probably caused by crosslinking between the extra hydroxyl group and the other polymer molecules. Crosslinked polymers generally have very low solubility in common polymer solvents. The specific viscosity, giving some indication of the molecular weight, is relatively low. This is probably because of the slight impurities present in the intermediates donated to me by various chemical companies

TABLE 1
Results of analysis for each polymer.

Polymer #	*Percentage Yield*	*Melting Point*	*Solubility*	*Specific Viscosity*
1.	47.4%	257° C.	s. *	.104
2.		128° C.		
3.	79.9%	173° C.	s.	
4.	44.6%	250° C.	s.	.251
5.	32.6%	221° C.	s.w.h.	.121
6.	83.0%			
7.	72.5%	275° C.	ins.	
8.	80.0%	274° C.	s.	.396
9.				
10.			ins.	
11.	33.6%		ins.	
12.	47.1%		ins.	
13.	15.1%		s.	
14.	11.7%		ins.	
15.	55.9%	270° C.	ins.	
16.	84.0%			

* solubility in m-cresol. s. = soluble. s.w.h. = soluble with heating. ins. = insoluble.

TABLE 2

The intermediates used in the preparation of each polymer.

olymer #	*Diamine*	*Diacid Chloride*
1.	1,6-hexanediamine	sebacoyl chloride
2.		orthophthaloyl chloride
3.		mono-ethylene glycol bis(chloroformate)
4.	ethylenediamine	sebacoyl chloride
5.	propylenediamine	sebacoyl chloride
6.		mono-ethylene glycol bis(chloroformate)
7.	trans-2,5-dimethylpiperazine	orthophthaloyl chloride
8.		terephthaloyl chloride
9.	cis-2,5-dimethylpiperazine	orthophthaloyl chloride
0.		isophthaloyl chloride
1.	2-methylpiperazine	sebacoyl chloride
2.	N-(2-hydroxypropyl) ethylenediamine	sebacoyl chloride
3.		orthophthaloyl chloride
4.		isophthaloyl chloride
5.		terephthaloyl chloride
6.		mono-ethylene glycol bis(chloroformate)

TABLE 3

Conditions that produced the best polymer for each polymeric reaction.

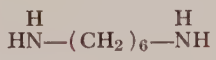
olymer #	*Organic Solvent*	*Acid Neutralizer*	*System*	Concentration in g/100ml *Water Phase*	*Organic Phase*
1.	CCl_4	NaOH	unstirred	2.2g	2.00g
2.	CCl_4	NaOH	stirred	2.90g	2.90g
3.	benzene	Na_2CO_3	stirred	3.74g	3.74g
4.	CCl_4	NaOH	unstirred	2.68g	2.50g
5.	CCl_4	NaOH	unstirred	2.64g	2.50g
6.	benzene	Na_2CO_3	stirred	2.32g	5.35g
7.	chloroform	NaOH	stirred	2.14g	2.86g
8.	CCl_4	NaOH	unstirred	2.80g	2.22g
9.	chloroform	NaOH	stirred	2.86g	3.34g
10.	chloroform	NaOH	stirred	2.86g	2.86g
11.	CCl_4	NaOH	stirred	2.86g	2.00g
12.	CCl_4	NaOH	stirred	2.97g	2.00g
13.	chloroform	NaOH	stirred	5.01g	2.86g
14.	chloroform	NaOH	stirred	5.01g	2.80g
15.	CCl_4	NaOH	stirred	5.01g	2.86g
16.	benzene	Na_2CO_3	stirred	2.53g	3.74g

TABLE 4

A list of the chemical formulas for the organic intermediates used in m preparation of polymers.

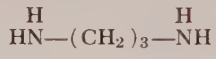
DIAMINES

hexanediamine —

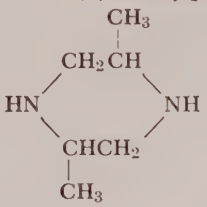


ethylenediamine —

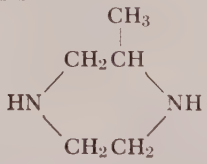
propylenediamine —



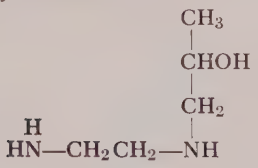
trans and cis* - 2,5,dimethylpiperazine



2-methylpiperazine —

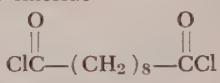


N-(2-hydroxypropyl) ethylenediamine —

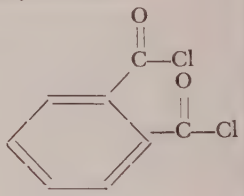


DIACID CHLORIDES

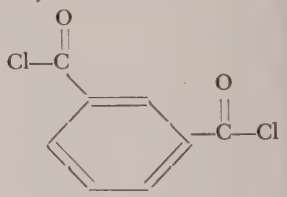
sebacoyl chloride —



orthophthaloyl chloride —

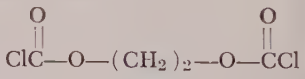


isophthaloyl chloride —



terephthaloyl chloride —

mono-ethylene glycol bis(chloroformate) —



* Trans and cis indicate geometric isomerism.

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Mystery of Enzyme Action

THE MYSTERY of how enzymes speed up chemical reactions in living things is on the verge of discovery according to Prof. Frank H. Westheimer, chairman, chemistry department, Harvard University.

Enzymes are giant proteins within the cells composed of thousands of atoms. At body temperatures they catalyze chemical reactions that scientists in laboratories can duplicate only at very high temperatures and with the assistance of strong acids, alkalies and other chemicals.

The complexity of enzymes makes experimenting directly with them extremely difficult. Prof. Westheimer and others have devised "chemical models," simple chemical compounds that in essential ways mimic the reactions of certain enzymes, with which to study the actions of enzymes.

Prof. Westheimer told the 5th International Congress on Biochemistry that two enzymes are particularly important. They are ribonuclease which catalyzes the break up of ribonucleic acid (RNA), and alcohol dehydrogenase, which transfers hydrogen atoms from sugar, starch and other substances to coenzymes, or special carrier molecules.

Ribonuclease is the first enzyme whose number and precise arrangement of amino acid building blocks is known, and a three-dimensional model of this molecule has been constructed. However, there is much yet to be solved about the workings of this enzyme.

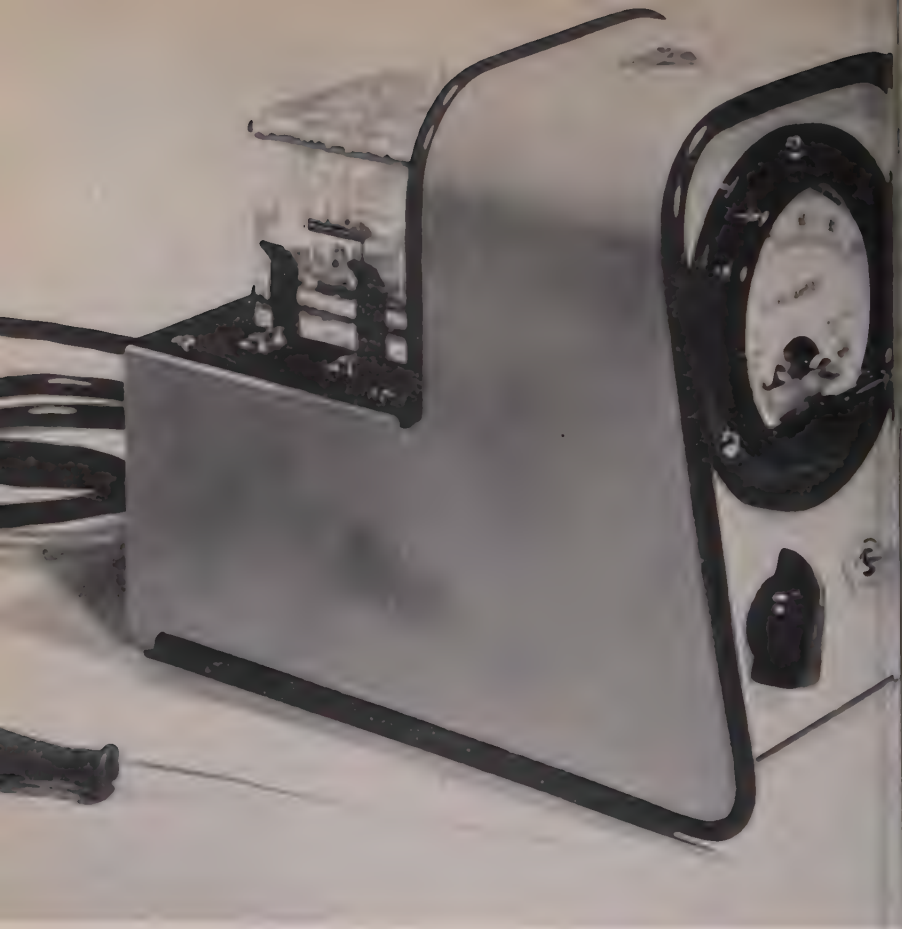
Every region in an enzyme is not active in catalysts. The "active sites" of ribonuclease are under study, as are the significance of the coiling and folding of the long molecule.

Although much is known about how alcohol dehydrogenase works, the arrangement of its amino acids is still a puzzle.

As progress in the field continues, Prof. Westheimer noted, the theory of enzyme action will become secure and chemists may be able to create synthetic catalysts like enzymes in the laboratory.

Radiation Decontaminator

WILD PLANT sap is being studied as possible decontaminator of radioactivity. During a basic research study involving energy flow of insects, Dr. E. P. Odum of the University of Georgia, Athens, accidentally discovered that insects that had been fed radioactive isotopes removed from their bodies the isotopes more rapidly than normal after feeding on wild plant sap in the field. Dr. Odum told the First Symposium on Radioecology that he planned to explore the discovery more thoroughly in the hope that it might lead to methods of decontaminating radioactivity on a larger scale.



Apparatus Article

Desalting Unit

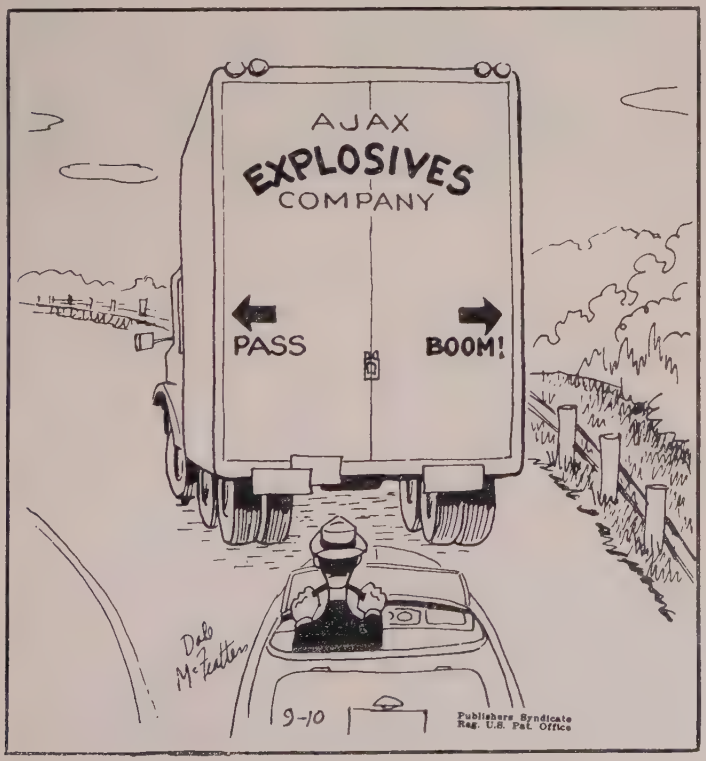
➤ Low-cost removal of inorganic salts from laboratory solutions prior to chromatographic separation is made possible by a new and compact desalter being introduced by The Torsion Balance Company, Clifton, N.J. This efficient laboratory apparatus provides better recovery of arginine than the mercury type desalter.

Overall the desalter measures 7″ x 6″ x 4″ and includes transformer, half-wave rectifier, potentiometer and

ree compartments separated by ion-change membranes. The central ompartment has a total capacity of 6 l divided into cells of 1, 2 and 3 ml. he clear plastic cells are virtually nbreakable and permit solutions to observed at all times. The cell unit ay be taken out for easy filling and mptying.

Outer compartments contain platium clad electrodes in acid solutions. on-exchange membranes are inexensive and have a life of not less an one year in continuous use. A asteur pipette and plastic plugs prode for stirring a solution in one cell during desalting without affecting other cells.

The front panel has a potentiometer control knob, toggle switch and meter reading from 0 to 100 milliamps. A small direct current causes positive and negative ions to pass into the end compartments through the ion-exchange membranes, leaving the center compartment free of inorganic salts. End of the desalting process, which takes only a few minutes, is indicated by a sharp drop in current on the meter. The solutions experience no temperature rise during desalting.



Rohm & Haas

This article continues a CHEMISTRY series that features the major companies employing chemists in the United States. Many of the students now preparing for a career in chemistry will eventually join one or other of the large corporations. This series is intended as a preview into the type of work that they will be doing.

➤ The activities of Rohm & Haas may be characterized, in brief, by two phrases: "Chemicals for Industry" and "Chemicals for Agriculture." One of the leading chemical companies in the United States, it has plants and laboratories in Pennsylvania, Tennessee, Texas, Kentucky, and offices throughout the world.

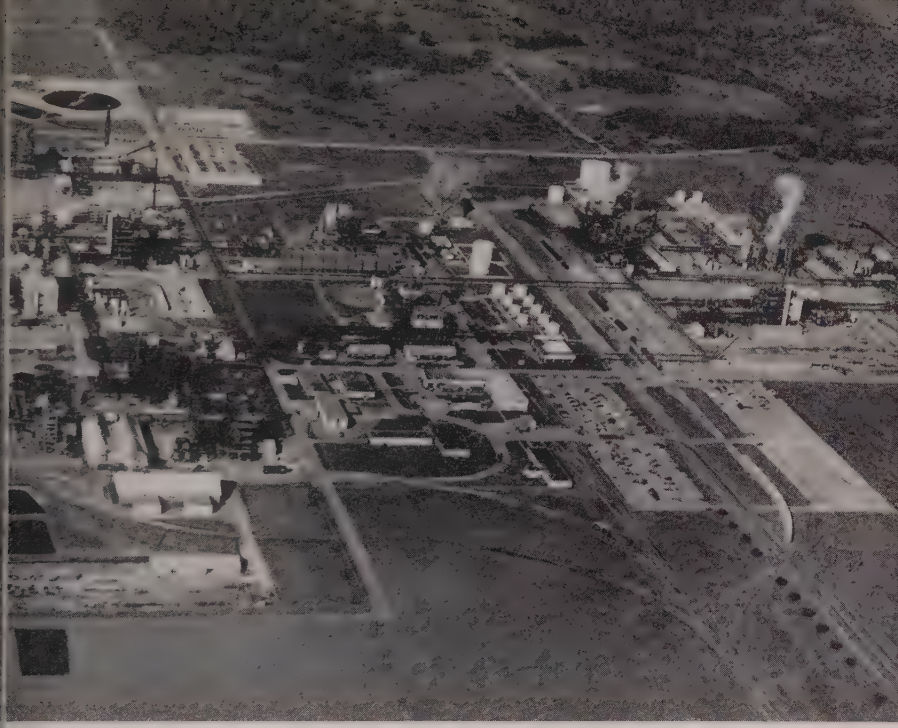
Of the over 700 industrial and agricultural products, only a few retain their identity at the consumer level. Probably the best known is Plexiglas, the acrylic plastic widely employed in the manufacture of internally lighted signs, for aircraft windows, automobile tail light lenses, fluorescent light diffusers, and numerous other items. The company also makes insecticides, miticides and fungicides, — under such trademarks as Rhothane, Karathane and Dithane — which are well known in the field of agriculture.

The remaining products, actually the bulk of those manufactured by the company, include resins for paints and varnishes, textile chemicals, resins for the paper and plywood industries, leather-making chemicals, plasticizers for the plastics industry, detergents and emulsifiers, petroleum additives, and chemicals to be used in the manu facture of other chemicals. Althoug most of these lose their identity i various finished products, the effect they impart do not, and almost every one in the country today is influence daily — although unknowingly — b one or more of these chemicals.

Early History

The Rohm & Haas Company ha its beginnings in 1903, when Dr. Ott Rohm, a young German chemist, in vestigated the possibility of replacin — with a manufactured material c standard quality — the non-uniform unsanitary "bates" which had bee used for centuries to prepare hide and skins for tanning. Dr. Rohm after considerable research work proved that the bating process de pended upon the action of enzyme and he succeeded in producing standardized bate, based on an enzym extracted from pancreatic glands. H named the product Oropon.

To manufacture and market Orc pon, a partnership was formed be tween Dr. Rohm and his friend an associate, Otto Haas, who in 190 introduced Oropon to the tanning in dustry in the United States. The prod uct in time became well establishe



Aerial view *of the Deer Park plant, Houston, Texas, of the Rohm & Haas ompany where the most recent installation is a plant for the production of etylene from natural gas.*

ıong leather manufacturers and, in 16, a plant was built at Bristol, ı. In 1917 Rohm & Haas Company ıs incorporated as an independent merican company. The firm's activi- s expanded substantially in the fol- wing years — not only in the de- lopment of additional chemicals for ıther manufacture, but also of prod- ts useful in a wide range of other dustries.

eather Chemicals

The leather bate, Oropon, had ought the young company into close contact with the leather industry and it was natural that the firm should develop other products for leather making. Mordants for dyeing, synthetic tanning materials, and finishes were successfully developed and have continued as important items in the company's product line.

Further work on enzymatic bates led the company into the field of industrial enzymes. Today Rohm & Haas Company is one of the nation's largest manufacturers of enzyme products. These materials — proteases, diastases, saccharifying agents, and

➤ Chemists *and engineers in the paper laboratory use this high-speed, pilot plant coater in the development of paper coating resins, one of the main products among the over* 700 *manufactured by the Rohm & Haas Company.*

pectinases — are used in the textile, food, brewing, wine-making and fruit juice industries.

Textile Chemicals

During the first World War, the growing company became the country's first domestic source of powdered sodium hydrosulfite, a textile reducing and stripping (color-removing) agent. Once familiar with the problems facing the textile industry, Rohm & Haas Company developed other products for the field, including formaldehyde sulfoxylates for stripping colo from fabrics; desizing enzymes; acryl ic finishes; and soluble urea-formalde hyde condensates for finishing rayon and cotton piece goods. The first sur face active agents (synthetic deter gents) were introduced in 1934. Since then they have found use in cleaning compounds, insecticides, rubber, paper and cosmetics, as well as in the textile industry. Research into surface active agents yielded a series of quaternary ammonium salts for antiseptics, dis infectants, and deodorants.

gricultural Chemicals

Investigations into insecticides in e mid-twenties resulted in the de- lopment of Lethane, the first syn- etic organic insecticide to be offered mmercially. This product — a com- nent of fly sprays, originally — is ll a widely used insecticide, but a mber of other agricultural insecti- les and fungicides have been added rough the years. The list includes thane, an insecticide of greater ef- tiveness than DDT for certain ap- cations; Dithane, a dithiocarbamate ngicide for the protection of crops m blight and other fungus diseases; lthane, an organic miticide; and rathane, a plant fungicide.

crylic Products

When Dr. Otto Rohm, co-founder the company, was a student, he was erested in the reactions of acrylic mpounds. Subsequently, chemists at hm & Haas extended this early re- rch work and many different acryl- products have now been developed commercial use. Acrylic resins in et form, sold under the now famous xiglas trademark, were introduced 1935, and Plexiglas molding powder s developed a little later. These ducts have found extensive use in craft, signs, automobile parts, light- fixtures, merchandising displays, d other applications.

Products chemically related to Plexi- s are widely used in paints, paper, ther, and textile finishing. Lubricat- oil additives represent another portant and rapidly growing use acrylic polymers. Acrylic com- unds in the monomer form are sold other chemical manufacturers for as chemical intermediates and in paring specialty resins.

Coatings and Plasticizers

The first products from Rohm & Haas for the paint and varnish field were modified phenol formaldehyde resins. These products made possible the first of the so-called "four-hour" enamels, and they gained rapid and widespread acceptance in the coatings industry. The company then developed other types of synthetic resins for paints, varnishes and lacquers such as plasticizers for nitrocellulose lacquers, alkyd resins, and organic-soluble urea formaldehyde resins for baking finishes on metal and wood. The acrylic emulsion, Rhoplex, was introduced in 1953 and is now used around the world in the manufacture of durable, water-based paints. Rhoplex emulsions also have broad usage in floor polishes.

Polymeric plasticizers, first introduced for nitrocellulose lacquer in 1929, were followed in later years by products specially designed to meet the need of the rapidly growing vinyl family of plastics. The permanence of plasticizing effect imparted by these plasticizers has made them the industry's standard of performance. Today the company is perhaps the nation's largest manufacturer of polymeric plasticizers as well as an important source of various types of monomeric plasticizers.

Ion Exchange

Shortly after 1940, the Amberlite ion exchange resins established their value in a host of varied industries for such purposes as water conditioning, purification of chemicals, recovery of valuable metals from dilute solutions, preparation of pharmaceuticals, and prevention of stream pollution. More

recently, the Amberlite ion exchange resins themselves have served as therapeutic agents in the treatment of bodily ills involving electrolyte balance.

Inorganic Chemicals

In 1920, the Rohm & Haas Company purchased the capital stock of Charles Lennig & Company. This manufacturer of heavy chemicals, located at Bridesburg (Philadelphia), Pa., was one of the oldest chemical firms in the country. Producing chemicals essential to the parent organization, it was operated as an associate firm until 1947, when its manufacturing and business operations were transferred to the Rohm & Haas Company. Among the chemicals produced by the Lennig Plant are sulfuric acid, various methylamines, sodium hyposulfite, and zinc chloride.

Careers in Science

In the development and sale of these Rohm & Haas products, men with a background of education in the sciences are afforded a great breadth of opportunity to use their knowledge in research, engineering, production, purchasing, sales, and sales development.

Men and women with undergraduate or graduate degrees in chemistry and allied fields are constantly in demand by the Research Division of the company. The research programs encompass all aspects of chemical technology from the basic, theoretical studies of reaction kinetics to applied research or customer service. Virtually all of the projects in the research laboratories bear in some fashion upon organic chemistry, and hundreds of organic chemists are employed by the company. However, physical chemist analytical chemists, biochemists, biol gists, and physicists are also essenti to the company's research efforts.

➤ The Craig *automatic counter-cu rent extractor shown separates com plex mixtures into their componer fractions.*

Engineers

Discovery alone will not bring th benefits of a new plasticizer, ion e change resin, or arcylic polymer t the consumer. The product must fir be produced in quantity, and reasonable cost. To that end, Rohm Haas Company employs a large sta of engineers — men whose job it to transform or adapt the process developed in the laboratory to pla scale. The engineering staff, havir achieved that goal via the design, d

opment, specification, and construction of equipment and buildings, is o responsible for the operation and intenance of the plants.

ant Expansion

Over the years, there has been a ntinuous expansion program result- from successful research on both w and improved products.

As part of a very general expansion ogram at all plant locations, the mpany is continuing to enlarge nufacturing facilities at Houston, xas, where hydrogen cyanide and her intermediates are produced. The st recent installation, a plant for production of acetylene from tural gas improves the basic position the company in raw materials es- ntial to the manufacture of arcylic oducts. The expenditures for new cilities at Houston represent the gest single investment in the history the company.

In addition to the many units at istol, Pennsylvania, a new labora- y building, part of a general ex- nsion program for research, has en erected. Also, a new research e has been purchased in suburban iladelphia, on which new labora- ies will be erected to meet the needs Rohm & Haas Company's steadily panding research program.

Plans are underway for the con- uction of a new home office build- at a location in Philadelphia facing e Mall on which Independence Hall located.

As a public service, Rohm & Haas Company has established and is operating substantially at cost, a laboratory for basic research and development of rockets and propellants at the United States Government Redstone Arsenal, at Huntsville, Ala.

In 1960, the company purchased a 138-acre government surplus plant in Louisville, Ky., at which location facilities for the manufacture of methacrylate monomer and adipic acid are now being installed.

Expansion Abroad

In recent years, demands from overseas for the company's products have increased in spite of currency exchange problems, and Rohm & Haas products are now exported to almost every country of the Free World. In some cases, plants have been constructed abroad to meet the rising demand. Between 1952 and 1961 small plants were put into operation by wholly owned subsidiaries in France, Brazil, Canada, England, Italy, Argentina, Australia, Peru, Mexico and by a jointly owned company in Japan.

The Future

Rohm & Haas is a company with a broad base of products — over 700 in all — and a vigorous, highly diversified research program. With such a foundation, the company's future is closely tied to the growth of the chemical industry. Since the chemical industry is growing rapidly, and serves the needs and desires of the public more and more effectively, the future of the industry and of the company is assured for many years to come.

√ Answers to CHEMISTRY QUIZ on Page 16.
A - 1; B - 2; C - 4; D - 2; E - 3. √

Radiation Caps "Hang" Above Both Poles

➤ A PAIR OF radiation polar caps are believed to "hang" over the North and South Poles.

These radiation zones are formed by particles from the sun that circulate around the polar axes. The radiation is believed to be strongest closest to earth and decrease outward, Drs. G. Sprague and C. W. Gartlein of the IGY Auroral Data Center, Cornell University, Ithaca, N.Y. reported.

The scientists said the radiation caps are similar to the Van Allen radiation belts circulating high above the earth like a big doughnut from about 40 degrees north to 40 degrees south latitude. Both are made up of particles, protons, from the sun deflected by the earth's atmosphere. In the polar regions such particles are responsible for the magnificent displays of northern lights, or auroras.

Drs. Sprague and Gartlein's theory about the aurora is that radiation areas must be present at about 20,000 miles above each pole. The hypothesis still has to be proved from satellite information about the travel of protons to earth and the formation of the radiation area, the scientists said. They believe auroras come down in the region between the Van Allen belts and the polar radiation caps.

The ideal satellite to find out something more about aurora protons should have a polar orbit (circle the earth over the poles) and be able to count particles of low energies. Most of the satellites now going up can only count particles of high energy, they said.

The satellite should also have a "window" of tinfoil, thin enough to let the particles through and thick enough to keep the atmosphere out. This kind of arrangement is difficult to manage, they said, as the "window" will break very easily.

The two scientists get first hand information about auroras from amateur observers living all over the northern U.S. It is important that such observers watch for auroras regularly and send information to the IGY Data Center as some information, for example about the blue light in auroras, can only be gathered by human observers. Much correlated information is necessary about each display.

However, at the present time magnetic storms on the sun, which cause the particles to be flung out in space toward earth, are decreasing and solar activity will be less and less until about 1965.

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New Trends in Chemistry

Reports on studies and applications in various fields of chemistry were presented at the New Trends in Chemistry Conference held by the Armour Research Foundation of Illinois Institute of Technology at Chicago, October 11 and 12.

ture Field Seen r Inorganic Polymers

OUR FAST moving technology is manding new materials of much ter thermal stability than we have ilable today, G. Barth-Wehrenalp Pennsalt Chemicals Company, iladelphia, Pa., reported. Attempts meet these more vigorous require-nts by modification of the organic stics used for gaskets, fluids, molded icles, sheets, tubes, etc. are limited the nature of the organic systems d it now appears that we are near limit of such materials.

With the exception of the silicones plastics used today are organic, t is, they are based on carbon-con-ning backbones. In the last decade d especially during the last few rs there has been much effort here d abroad directed toward the syn-sis of polymers with inorganic kbones. For example, considerable earch has been done on the substi-ion of various elements for part or of the silicon in silicon-type materi-. Both American and Russian in-tigators are working in this field.

Wholly inorganic linear macromo-ular systems include plastic sulfur, ssy selenium and the phosphoni-trilic chloride rubber. None of these substances, however, exhibits sufficient thermal stability or else does not have the necessary properties to make it a practical high-temperature plastic.

The problem then becomes one of "molecular engineering." Although it is relatively easy to write formulas for inorganic polymers, consideration of such systems must be based on theoretical justification in order to arrive at practical materials. Here one finds the synthetic inorganic chemist — not to mention the inorganic polymer chemist — very much handicapped by the lack of basic information. In fact, inorganic polymer chemistry is today where organic polymer chemistry was about thirty years ago. Much of the effort, therefore, was and must continue to be directed toward obtaining the much needed background information.

High Polymers Used At High Temperatures

➤ ONE OF the most challenging tasks in polymer chemistry is the synthesis of materials which exceed in their melting points and thermal stability substantially the existing organic polymers, some of which can be used with success at temperatures above 350°C

Herman F. Mark and S. M. Atlas, Polytechnic Institute of Brooklyn, Brooklyn, N. Y., reported at the conference. To arrive at products which could sustain 450 or 500°C. for prolonged periods, it appears to be necessary to incorporate into the molecule on top of the normal "organic" elements, C, N, O and H, one or more of typically "inorganic" compounds such as, Ba, Mg, Al, Si, P, Sn, or Ti, and to rely on the strength of some polar or semi-polar bonds such as, —O—Mg—, —O—N— and —O—Si.

Another area of interest deals with polymerization reactions of materials containing conjugated double bonds, which may be effected on the surface to be coated by adding a suitable catalyst to the vehicle either immediately preceding application or by simultaneous spraying from two separate containers. That is, styrene can be catalyzed with $SnCl_4$ in the presence of ultra-violet light.

The capacity to prepare stereoregulated polymers has been considerably improved both in respect to the degree of stereoregulation and to the number of monomers which can be successfully brought into a regulated macromolecule. Closely controlled conditions in the preparation of certain Ziegler-Natta catalysts and of anion lithium alkyl and aryl initiators have made it possible to obtain cis-polyisoprenes and polybutadienes up to and beyond 95% cis structure and special combinations of titanium subhalides with aluminum alkyls have produced polypropylenes with similarly high degrees of isotacticity.

Non-hydrocarbon type monomer such as vinyl halides, arcylates and methacrylates have been obtained in stereoregulated, well-crystallizable modifications and it is highly probable that catalysts will be found which are capable to stereoregulate the polymerization of all vinyl, arcylic and allyli monomers.

Polymer systems have proven useful for photo-mechanical systems such as photo-engraving. However, they are severely limited in their use in photography, particularly because of their insensitivity to visible light. Recent work has shown that polymers containing mercaptan groups can be cross-linked by visible light using dyes as sensitizers. These dyes, in the presence of suitable electron donors will sensitize the bichromate reaction thus converting this method to a visible light process. High polymers which have been cross-linked by metal ions can be sensitized so as to collapse, that is, lose their gel characteristics by exposure to visible light.

Non-Aqueous Solvents Used in Chemical Processes

➤ The increasing application of non-aqueous solvent systems to chemical processes is made possible by advances in the understanding of the nature and concepts of these systems Joseph J. Katz and Irving Sheft, Argonne National Laboratory Lemont, Ill., told the conference. The increasing availability of resistant materials of construction, and new methods of handling have also greatly accelerated the use of these systems. The problems and needs of the atomic energy pro

ram, in particular, have supplied a reat impetus to recent work in the eld.

ses and Limitations f Radiation Chemistry

It has been known for over 50 ars that ionizing radiation can cause anges in chemical systems. Paul Y. ng, Armour Research Foundation Illinois Institute of Technology, nicago 16, Ill., pointed out, however, at it is only during the recent years at radiation chemistry has grown om a subject of purely academic in- rest to one that is both essential to e further development of other anches of nuclear technology and omises direct application.

Because of the unique nature of the action intermediates and mecha- sms involved, radiation processing ethods can sometimes be used to itiate reactions not always possible conventional procedures. However, ere are also limitations in the utili- tion of this relatively new form of ergy source he said.

hermodynamics of reversible Processes Discussed

A brief survey of the directions in nich thermodynamics has moved nce 1923 was made by R. J. Tykodi, ssistant Professor of Chemistry, linois Institute of Technology, nicago 16, Ill., who compared the ntents of the second edition (1961) the well-known text by Lewis and ndall with that of the first edition 923). A new offshoot of the thermo- namic way of doing things, the ermodynamics of irreversible proc- esses, was taken up in detail. Some simple techniques for handling non-equilibrium situations involving stationary states and steady-rate processes were also discussed, and illustrated by the Joule-Thompson porous plug experiment, the thermomolecular pressure effect, and the forced vaporization of liquids.

Research in High Temperature Chemistry Advanced

➤ The reliable prediction of chemical and physical phenomena over wide ranges of temperature up to 10^8 °K requires a detailed knowledge of the atomic, molecular and ionic species present, including structures and thermodynamic properties said John L. Margrave, Department of Chemistry, University of Wisconsin, Madison, Wis. Since the number of chemically plausible combinations of the atoms at high temperatures is astronomically large, much effort is presently going into the preparation and identification of high temperature species by use of plasma arcs, unusual flames, induction heaters, solar furnaces, shock tubes, flash heating devices, etc. In addition, thermodynamic and molecular properties are being determinated with calorimeters, mass spectrometers, infrared and microwave spectrometers, X-ray and electron diffraction apparatus, and other classical devices modified for high temperature operation.

New Ion Exchange Resins And Membranes Discussed

➤ New ion exchange resins and membranes developed in the last few years, were discussed by Harry P. Gregor,

Polytechnic Institute of Brooklyn, Brooklyn, N. Y., both those that have been commercialized as well as those not yet commercialized. The newest uses for these materials include the separation of amino acids, the removal of salts from proteins, the concentration of salt from seawater, the production of potable water from salt-containing waters and the recovery of sulfuric acid from waste soultions.

Chemical Kinetics Is Expanding Field

➤ THE EMPIRICAL equation of Arrhenius and its elucidation in terms of inelastic collisions between spheres has been replaced by a more acceptable approach in terms of the properties of an intermediate complex of definable energy and entropy, Martin Kilpatrick, Argonne National Laboratory, Lemont, Ill., reported. The development of activated complex theory in terms of a potential energy surface barrier together with the use of isotopes and radical reactions of low activation energy have led to a powerful theoretical formation of rate processes and a broad understanding of the general field. The development of new experimental techniques has resulted in a rapid expansion in the publications in the field of kinetics. This expansion of the literature presents many problems for the future specialist.

The topics discussed include fast reactions, oxidation of hydrogen and hydrocarbons, polymerization, nitration and sulfonation and metal-water reactions.

Metal Chelates Used To Control Metal Ions

➤ PRINCIPLES of complex formatic were used by Arthur E. Martell, Il nois Institute of Technology, Chica 16, Ill., to show how the properties metal ions may be modified or greatl altered by reaction with various typ of complexing agents. Equilibriu data that have recently become ava able were employed to predict quan tatively the use of complexes to modi tendencies of metal ions to precipita hydrolyze, and undergo redox rea tions. The concept of the use of o ganic chelating agents as metal buffe to control metal ion activities we explained, and pertinent applicatio of metal chelates were given. T special advantages of metal chelat in very dilute solution were interpret on the basis of the "chelate effect."

The functions of metal ions an metal chelates as catalysts in solvoly and oxidation-reduction reactions, an the control of such reactions by co plex formation, were described.

Crystal Defects Are Basis Of Solid State Chemistry

➤ SOLID STATE chemistry or the scien of crystal imperfections was discuss by F. Schossberger, Armour Resear Foundation of Illinois Institute Technology, Chicago 16, Ill. The o gin of defects and their relation the preparation of reactive substanc was described and X-ray and electr diffraction diagrams were interpret for the purpose of investigation different types of amorphous materi and small particles. A brief discussi of the solid state theory of semico

ictors was followed by examples of crious crystallization phenomena and eir relation to crystal defects. The amples included impurity defects in rmanium, luminescence phenomena, alking of outdoor paints, caking of lts, texture of ice cream, action of our point depressants in oil, measure- ent of intramicellar spaces in fibers, d preparation and purification of ge semiconductor crystals.

ew Knowledge Gained n Catalytic Reactions

Considerable progress has been ade in the field of catalysis during e recent years Vladimir Haensel, niversal Oil Products Company, verside, Ill., reported. First, highly ective reactions have been effected a commercial scale through the e of dual function catalysts. Second, uch knowledge has been gained of e intermediates in catalytic reactions rough the use of new tools such as frared spectroscopy, magnetic sus- ptibility and surface studies. Much the effect in these fields concerns e observations of the changes that ke place during a catalytic reaction.

The petroleum industry offers an cellent example of the rapid accept- ance of new catalytic methods. The use of dual function catalysts for re- forming makes it possible to effect a substantial increase in the rate of a number of hydrocarbon reactions. These reactions consist of a large number of individual steps involving migrations from one site to another.

Organic Semiconductors Penetrate Many Scientific Fields

➤ The study of organic semiconductors is a good example of modern research which steps boldly and simultaneously into at least four traditional scientific disciplines, physics, organic chemistry, polymer chemistry, and biology reported Herbert A. Pohl, Princeton University, Princeton, N. J. It must be guided at all times by those most fundamental laws as expressed in quantum mechanics, yet rely upon the remarkable intuitive insight of the organic chemist.

Man uses organic semiconductors in making resistors, objects to them in his insulators. He studies them to learn their role in important biological processes such as vision, cancer inception, and photosynthesis and also for their numerous potential industrial uses.

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Support for Industrial Research

➤ Federal financing of industrial research and development by private firms was more than four times heavier in 1960 than in 1953, the National Science Foundation reported in Washington.

The annual total for Government sponsorship of research and development projects has climbed from $1.4 billion to $6.1 billion in the seven-year period.

The Government financed 58% of the $10.5 billion in projects reported for 1960. Its share of the 1953 total was only 39%.

Federal funds accounted for 87% the research and development don by the aircraft industries and 68% that done by the electrical equipme and communications industries. I dustries largely self-supporting i cluded paper, drugs, oil refining an extraction, and stone, clay and gla products.

The overall $10.5 billion figu represented a 10% increase from th $9.6 billion tallied for 1959. Feder participation has shown an annual i crease of seven percent or more ea year since 1953.

Second Plant for Soft Water Conversion

➤ The second of five plants demonstrating how salt or brackish water can be turned into drinkable water was dedicated in Webster, S. Dak., by Secretary of the Interior Stewart L. Udall.

The plant uses an electrodialysis process to reduce the salt content of local well water from about 1,800 dissolved parts of salt per million gallons of water to about 300 quarts per million. It can produce 250,000 gallons of water per day, more than enough to meet the requirements of the Webster community, which has previously used brackish water.

The electrodialysis process uses the property of certain plastic membranes to pass only electrically positive particles and of other membranes to pa only electrically negative particl When salts are dissolved in wat they break up into equal quantities positively charged and negative charged particles that will move opposite directions in an electri field.

The first saline water conversi demonstration plant was dedicat June 21 in Freeport, Texas. A thi plant is nearing completion in S Diego, Calif. These, plus others bei designed for Roswell, N.M., an Wrightsville Beach, N.C., will demo strate the engineering, operating a economic potentials of the five mo promising methods for converting s or brackish water to potable water.

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New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupon (but not stamps) for each patent ordered.

ernal Insecticide r Mammals

SPECIAL dilutions of dithiophosates as systematic insecticides in mmals won patent No. 3,007,845 Redginal Irving Hewitt of Nanuet, Y., and Emanuel Waletzky of estwood, N. J. Rights were assigned American Cyanamid Company, w York City.

The drug, administered internally, ls insects and other parasites that d on or in domestic animals.

An important advantage of the new ig is that it is rapidly metabolized the body of the animal so that the h is soon safe for human consumpn.

ovel Neutronic actor Structure

A NEUTRONIC reactor structure of ovel construction" won patent No. 05,764 for Dr. Farrington Daniels the University of Wisconsin, who igned rights to the U.S. Governnt. His invention is a nuclear reor that can be operated at very h temperatures for the most icient use of the power generated the reactor.

Dr. Daniels uses a fissionable comind with a high melting point, such uranium dioxide dispersed through the reactor and held in place by inder of the moderator material, ich can be beryllium oxide or phite. In this way the moderator terial gives physical support for the particles of the fissionable material, thus raising the temperature limits at which the reactor can operate.

Device for Controlling H-Bomb Fusion Patented

➤ A MACHINE that can be used to control the firey energy of the hydrogen bomb's fusion reactions was patented.

It is called a "rotating plasma device," a plasma being a gas in which the atoms have been partially ionized, or separated into positive ions and negative electrons. Although electrically neutral as a whole, a plasma can conduct an electrical current.

The rotating plasma device will come into its own only after scientists have achieved long-time confinement of a plasma. This is the key to controlled thermonuclear fusion of such light elements as hydrogen, deuterium (double-weight hydrogen) and tritium (triple-weight hydrogen).

There are four basic methods being tested for confining a plasma, co-inventor James L. Tuck of Los Alamos Scientific Laboratory, Los Alamos, N. M., said. These are the so-called "pinch effect," which has been found to be unstable; the Stellarator, a machine being built at Princeton University; the mirror configuration; and the "picket fence," which is based on cusped geometry.

The "picket fence" method is the most recent and most promising approach, Mr. Tuck said. However, he noted, there are "many, many" com-

binations of these four methods being tried out at various laboratories around the country.

Patent No. 3,005,767 was awarded to Drs. Keith Boyer, Conrad L. Longmire, Darragh E. Nagle and Fred L. Ribe, and Jay E. Hammel and Mr. Tuck who assigned rights to the Government through the U.S. Atomic Energy Commission.

Their invention relies principally on the fact that an ionized gas can be contained and heated in a region of crossed magnetic and electrical fields. Both fields are applied externally, so there is no reliance on the self-generated magnetic field of the plasma current to compress and thereby heat the plasma as in the "pinch effect" approach.

The rotating plasma device is one of the methods for obtaining a high rate of thermonuclear reactions, with more energy liberated than is required to ionize the gas and bring it to the extremely high temperatures necessary for controlled fusion.

Explosive Method For Offshore Exploration

➤ An improved method of exploring for oil in offshore areas without killing large numbers of fish won patent No. 3,006,279 for Robert W. Lawrence of Wilmington, Del.

The shock wave from dynamite exploded in water during seismic explorations can kill large numbers of fish, which is forbidden by fish and game authorities in some areas. Although firing black powder instead of dynamite reduces the fish kill, the seismic record obtained is not very satisfactory, Mr. Lawrence said.

Separation of Neptunium from Plutonium

➤ Dr. Glenn T. Seaborg, chairma of the Atomic Energy Commissio was awarded patent No. 3,005,680 f his method of separating neptuniu from plutonium when both are d solved in water. His application f the oxidation method of separati was filed on Feb. 2, 1948, but publi tion of the patent was delayed f security reasons. Dr. Seaborg assign rights to the U. S. Government represented by the AEC.

Enzyme to Speed Up Wound Healing

➤ Jay Morton Beiler and Gustav Martin, Philadelphia, Pa., have i vented four new compositions claim to speed the healing of wounds. Righ of patent No. 3,003,917 were assign to the National Drug Company, al of Philadelphia. The compositio consist of relaxin, a proteolytic e zyme or enzymes and an amyloly enzyme or enzymes. They can be a ministered both in solution and the form of an ointment.

Boosts Value of Irradiated Diamonds

➤ Public taste makes colorless bluish diamonds more valuable th pale yellow or brown diamonds. put yellow and brown stones in higher price range, three invento have patented an irradiation proc that changes the color of diamonds rearranging their crystal structure.

Patent No. 2,998,365 was issued Jan. F. H. Custers, Johannesbu Union of South Africa, and Henry Dyer and Robert W. Ditchburn, bo of Reading, England. Rights we assigned to Industrial Distribut Limited.

Radiation Test For Space Metals

Metals for nuclear-powered spacefft will soon be tested to see how y would stand up under the fierce liation generated by the power irce.

The tests will be the first of their id ever made on different alloys of inium, aluminum, and stainless el at sub-freezing temperatures.

Patrick L. Donoughe, manager of Plum Brook reactor, Sandusky, io, said that testing these metals ll be the first experiment to be dertaken when the reactor goes to full power of 60,000,000 watts.

He said the reactor, a facility of the tional Aeronautics and Space Adnistration's Lewis Research Center, eveland, will provide a new tool for dying parts and materials under nditions similar to those anticipated fully nuclear-powered systems for icecraft.

Radiation from the reactor will be amed at the metals at minus 430 grees Fahrenheit to see if they uld be suitable for storage tanks lding liquid hydrogen. Liquid hydgen must be stored at minus 423 degrees Fahrenheit or less.

The hydrogen might be used as a propellant for spacecraft and kept in a tank close to the nuclear power source on board. It is not now known which metals would stand up under the simultaneous stress of the extremely low temperatures and the radiation from the power generator.

The tools needed for the testing are the reactor and a big refrigeration system, consisting of compressor units, expansion engines and heat exchangers to provide the needed low temperatures.

The reactor will build up power as soon as the Atomic Energy Commission inspects it during a shutdown period. It has recently "gone critical," generating more than enough neutrons to sustain the nuclear fission process. This marks the end of the reactor's test run since its completion last April.

Future experiments with the Plum Brook reactor could include the investigation of how much shielding is required to keep astronauts safe from nuclear radiation from a power source.

On the Back Cover

The Back Cover *shows a new silicone encapsulating material that permits ual inspection of circuits and components within potted, embedded or enpsulated assemblies. Developed by Dow Corning Corporation it is designated Sylgard* 182 *Resin. Applied as an almost colorless liquid after blending with curing agent the resin cures in place to form a transparent mass having tstanding dielectric properties, good moisture resistance, toughness and flexiity. It can be twisted or rolled to conform with unique circuit placement quirements and sections can be cut out for repair of components.*

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Announcing new developments in the chemical industry and newly available chemical literature.

Germanium Research Center

➤ A CENTER for the study of developments in the field of germanium, and for the encouragement of germanium research, has been organized at Midwest Research Institute, Dr. Buell Beadle, director of the Chemistry Division has reported.

To be known as the Germanium Information center, the office is unique in this country. Its formation is being sponsored by the Germanium Research committee which includes representatives of several U.S. and foreign mining corporations. The sponsors include American Zinc Lead and Smelting company, the Eagle-Picher company, Societe de la Vieille Montagne, Tsumeb, corporation, Ltd., and Union Miniere du Haut-Katanga.

H. H. Young, a Midwest chemical engineer and research coordinator for the center, explained that germanium is a relatively "new" metallic element discovered in 1886 by the German chemist, Winkler. Included in the tin group, the metal has a whitish, silvery appearance and in recent years has become a vital importance in the manufacture of transistors and similar electronic components.

Found in zinc deposits, geranium is a relatively expensive product. Germanium chloride sells for about $145 a pound. Midwest has been engaged in basic research studies relating to the element for several years and has been issued a patent relating to a project for recovery of the elemer from ash.

Prime objective of the center is t correlate all international informatic on germanium in order to maintai an up-to-date reference file. An equa ly important aim is to seek new use for the metal and to develop metho for predicting future trends an markets.

New Beryllium Source

➤ THE BRUSH BERYLLIUM Compan the world's largest producer of bery lium products, has announced tha for the first time, beryllium metal ha been successfully produced from th recently discovered Topaz Mountai ore deposits in Utah.

Bengt R. F. Kjellgren, Board Chai man of Brush stated that their pil plant experience conclusively demor strates that the extraction of berylliu metal from Topaz ore is economical feasible. Currently, beryllium produ tion is dependent upon beryl or more than 90% of which has been im ported from Africa, South Americ and other foreign sources.

Last fall Brush scientists and eng neers succeeded in turning out su stantial quantities of beryllium h droxide from the Topaz ore. This the intermediate compound fro which beryllium oxide, berylliu metal and beryllium alloys are mad

Beryllium metal was first produce from Topaz ore early this month i the form of pebbles. Prior to the pr

ction of pebbles, beryllium oxide, a terial used in high-temperature amic bodies, had been made by ush from Topaz ore.

The chemistry of extracting beryl- m from Topaz ore proved consider- y different, Kjellgren said, from t used to process beryl ore. The wly-developed Brush process in- ves a series of mechanical and mical steps to separate out a semi- rified beryllium compound which hen purified to yield beryllium.

Topaz Mountain area, is thought contain at least 3,000,000 tons of in staked claims containing 0.75% more of beryllium oxide. A sub- ntial and dependable domestic sup- of beryllium ore is essential be- se of increasing demand for the tal for space and nuclear projects. has the highest strength-to-weight io of any structural metal. Beryl- m is as light as magnesium and be used at temperatures up to 00°F. It is also a good moderator l reflector of neutrons and is being d in nuclear reactor applications.

mbustion Control Additive

ETHYL Corporation has announced availability in development quan- es of "Ethyl" Ferrocene, or dicyclo- ntadienyl iron.

The compound, Ethyl pointed out, finding growing applications as a nbustion control additive, as a high nperature lubricant, as an inter- diate for thermally stable polymers l for radiation resistant polymers, l also as an ultraviolet absorber.

Ferrocene, which was discovered in 1, has been attracting increasing ntion in the last decade, first, because of its unique chemical and physical properties and, second, because it has led to broad new research and development work in the whole field of organometallics. It is a so-called "sandwich" compound in which an iron atom is sandwiched between two cyclopentadienyl rings lying in parallel planes. Its discovery has led to the synthesis of numerous other organometallic sandwich compounds.

The reactions of ferrocene, Ethyl points out, are in many ways similar to the aromatics. Its case of oxidation is the greatest difference between it and the aromatic compounds. The compound, which has a low order of toxicity and is thermally stable, is highly soluble in hydrocarbons but insoluble in water.

Ethyl is producing the compound at its Orangeburg, S. C. plant, using cyclopentadiene as a raw material.

New Synthetic Rubber

➤ A NEW synthetic rubber from the petroleum derivative, butadiene, having a remarkably regular molecular structure, and the catalytic agent that makes the synthesis possible, were the subjects of a paper presented before two divisions of the American Chemical Society in Chicago, Ill., by Dr. Morris Gippin, research chemist for The Firestone Tire & Rubber Company, Akron, Ohio. The paper was part of a symposium on "Elastomers From Petroleum Hydrocarbons" sponsored jointly by the Division of Rubber Chemistry and the Division of Petroleum Chemistry.

The new rubber, a polybutadiene whose building block units form a long chain molecule of exceedingly high regularity in geometric configu-

ration, such as normally found in natural rubber, has been achieved in the laboratories of The Firestone Tire & Rubber Company.

The catalyst, the key to the process, is a diethylaluminum chloride-cobalt chloride compound, which, by itself, is completely inert. Dr. Gippin, with the assistance of Mr. George B. Mitchell, carried out the research work at Firestone which led to the discovery of how to "trigger" this catalyst by modifying it with minute traces of water or oxygen, thus enabling it to polymerize butadiene.

Butadiene has been utilized as one of the copolymers in the common synthetic rubbers, known as SBR rubbers, for many years. Polybutadiene itself has been known for many years also, but because of the random geometric configurations it possessed, has had limited usefulness.

The catalyst is one of the so called stereospecific catalysts that causes the molecules to arrange themselves in a regular repeating pattern imparting many desirable properties to the resulting polymers. Prior to the use of these catalysts, polybutadiene was produced in aqueous emulsion, using conventional polymerization catalysts known as free radicals. The polymer thus formed was made up of monomeric units attached to each other in mixed geometric form. The most desirable structure only occurred in about 20% of the polymer. By contrast, in the Firestone polymer the regular desired pattern occurred in 98% of the polymer.

An important feature of the catalyst system is the very low amount of the cobalt component required for effective catalysis. Polymerization is produced with four thousandths of one percent of the cobalt based on the weight of butadiene.

The diethylaluminum chloride, cobalt chloride-pyridine complex and water form a soluble catalyst system which will completely polymerize the butadiene in about four hours at degrees centigrade to a polymer high molecular weight and practically entirely uniform in geometric structure.

First Polyisoprene Latex

➤ The Synthetic Rubber Division Shell Chemical Company has announced successful commercial production of a completely new product Shell Isoprene Rubber Latex, at Torrance, Calif., plant. The product is the result of a major research effort to produce cis-1,4 polyisoprene latex which is esentially equivalent natural rubber latex.

During the past year Shell Chemical has been conducting a market development program with this new latex, and because of the interest, has proceeded to commercial scale manufacture. It has a high solids content large average particle size, good mechanical stability, low chemical stability allowing quick gellation, low emulsifier content and exceptional low odor.

The product is of particular interest to manufacturers of dipped and molded goods (gloves, balloons, etc.), latex foam rubber, rug backings, adhesives and fabric coatings. Products have shown exceptionally good tensile strength, low shrinkage and excellent color.

New Products From Fluorosilicones

Development of the first commercially marketable line of fluorosilicones, semi-inorganic chemical products that resist heat, cold and oxidation, was reported by Dow Corning Corporation, Midland, Mich. Fluorosilicones are chemical cousins of the silicones used widely during the past ten years as oils, greases and plastics. The basic difference is that in fluorosilicones, fluoroalkyl groups are substituted for some of the methyl groups in standard silicones. This is said to produce compounds with the additional properties of good solvent resistance and improved lubrication qualities.

Air Pollution, A Modern Age Plague

The United States is suffering in the era of the super-city where, by 1970, three out of every four people will be breathing the air supplied over less than 10% of the country's total land area.

This air is burdened annually with the waste products of more than 40 billion pounds of synthetic organic chemicals, not to mention the waste from thousands of tons of nuclear production, Dr. Richard A. Prindle, deputy chief of the U.S. Public Health Service's air pollution division, said in Philadelphia. The effect that this man-made environment may have on national health cannot be precisely determined, but "we can say with absolute assurance . . . that our present position is almost parallel to that of Pasteur's predecessors who, acting on circumstantial evidence, cleaned up city filth and made striking progress toward better health," Dr. Prindle told the Annual Conference of the Philadelphia Tuberculosis and Health Association.

The threat to health from polluted air is not just limited to the super-cities. Masses of air pollution are carried from urban centers to vegetation and animal life literally hundreds of miles away from the source.

Heavy pollution of waters by cities also affects the quality of waters out in the country, he noted. Damage to the needles of trees in the remote pine forests have been traced to city-produced air pollutants.

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REPORT OF THE NATIONAL CHEMICAL LABORATORY, 1960 — C. E. H. Bawn, Chmn. — *Dept. of Scientific & Industrial Research (Brit. Inform. Serv.),* 70 p., illus., paper, 85¢. New research in chemical thermodynamics, new materials, and extraction and corrosion of metals.

BIOCHEMISTS' HANDBOOK — Cyril Long, Ed., with Earl J. King and Warren, Consult. Eds. — *Van Nostrand,* 1, 192 p., illus., $25. Presents in concise form a wide range of biochemical data, both qualitative and quantitative, arranged for quick reference to serve biochemists and those engaged in closely allied fields.

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THE CONDENSED CHEMICAL DI TIONARY—Arthur and Elizabeth Ro Eds., formerly directed by Francis M Turner, 1889-1952 — *Reinhold,* 6 ed., 1257 p., $17.50. Completely r vised and enlarged chemical referen work with up-to-date information uses, formulas, derivations, properti chemicals, materials, trade nam synonyms and safety regulations.

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PHYSICAL CHEMISTRY — Farringt Daniels and Robert A. Alberty *Wiley,* 2nd ed., 477 p., illus., $8. Revision emphasizes mathematical a proach, contains new material kinetic theory, spectroscopy, and s tistical mathematics.

THE PRINCIPLES OF CHEMICAL EQ LIBRIUM: With Applications in Che istry and Chemical Engineering Kenneth Denbigh — *Cambridge,* 4 p., paper, $2.95. Reprint of 1955 e

Chemistry Comments

Interesting facts in the chemical world.

Tritium, the radioactive isotope of drogen, disintegrates by emitting a particles of very low energy.

A super-magnet the size of a dough- t and a pound in weight that ates a magnetic field twice as strong that from a conventional iron-core ctromagnet as large as an automo- e and 20 tons in weight has been veloped.

Some pesticides on exposure to athering assume more toxic forms n in the one originally used.

Superconductors are materials which ve the property of losing all electri- resistance at temperatures near solute zero (459.7 degrees below o Fahrenheit).

Radioactive wastes differ from all er wastes in that they cannot be dered innocuous by chemical or logical treatment.

Dried and powdered blister beetles t contain a powerful organic sub- nce called cantharidin have been d medically from times of the ly Greeks.

X-ray patterns, called Laue patterns, formed when X-rays, on passing ough a crystal, are bent, or dif- cted, by the orderly arrangement atoms composing it.

One-half of the people in the world st on diets deficient in animal teins.

➤ A new electronic system that brightens a thousandfold the X-ray images from which the atomic architecture of crystals is revealed has been developed.

➤ Inadequate lime levels in the soil result in inefficient use of applied fertilizer and lower crop yields.

➤ Beryllium, the newest of the light metals used in producing today's missiles and spacecraft, has been known for centuries as a jewel, the emerald.

➤ Beryllium was first produced in pure form about 20 years ago.

➤ Fluoridated water apparently contributes to the development of straight teeth as well as to the prevention of tooth decay.

➤ Enough water is stored in the Antarctic ice cap to raise the world's seas an estimated 300 feet and submerge many of the greatest cities.

➤ Isotopes can be used as radioactive markers to investigate pattern of insect dispersion, rate and distance of their spread, length of survival after release and population densities.

➤ Engineering studies have indicated that manganese nodules, probably the most common form of hard rock found at the surface of the lithosphere, the hard part of the earth, could be an economic source of many metals.

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